PRACTICAL ANATOMY

VOLUME I

PRACTICAL ANATOMY

THE STUDENT'S DISSECTING MANUAL

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IN TWO VOLUMES

VOL. I

THE HEAD AND NECK: THE LOWER EXTREMITY

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PREFACE

We began this book with the idea of leaving out as many facts of Anatomy as we dared, because we felt that the modern medical student, with only some fifteen months at his disposal, could not be expected to master the whole of Anatomy or to exercise any sound choice as to which parts of it he should neglect.

As the work went on we found that some of the facts which we had omitted were valued by other teachers, and so they were replaced; and although there is still a great deal of anatomical knowledge purposely omitted from this book, we hope that it will be found to include all that is necessary for the use of students.

The omission of comparatively unimportant detail has rendered small and large type unnecessary, we think. In any case, we are glad to be without small type, because, in our experience, students usually pay more attention to the minutiæ contained in it than they do to the essential facts embodied in the large print.

The question of nomenclature has given us much anxious thought, and we have come to the conclusion that the time is not ripe for the exclusive adoption of the revised anatomical nomenclature. We do not dare, for instance, to send a student into the wards understanding that the radial nerve is a structure in the upper arm, when, to his surgeon, it is a structure in the forearm. There is little doubt, however, that the new nomenclature will gradually assert itself, and we have gladly placed the modern name in square brackets

after the name at present used, in every case in which the two differ.

We are very grateful to the numerous clinicians and specialists who have been kind enough to read through various parts of the work and to advise us on points of detail possessing practical value. To Dr. Box, Mr. Sargent, Mr. Fisher, Mr. Marriage, and Dr. Wood Jones we are especially indebted.

We may justly claim that, after deciding how much we could leave out, our endeavour has been to lay stress, firstly, on the technical methods of displaying the various structures successfully; and, secondly, on the positions and relations of structures which experience shows are of practical importance.

In preparing the illustrations the help of Messrs. Bluett, Cowtan, Morris, and Vevers was of the greatest value to us. All these gentlemen have been our own students, and all the figures which show any artistic merit were drawn by one or other of them. The others are either diagrams or outline sketches made by ourselves with the aid of a diagraph.

In a certain number of cases the illustrations are a reproduction of the dissection which the student is making, but this is only when we have doubted whether he will recognise the various structures from the description in the text.

More often the illustration is arranged to show the parts from a somewhat different point of view to the one seen in the student's dissection, in order to help him to acquire a sense of topography.

F. G. PARSONS.
WM. WRIGHT.

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HEAD AND NECK

LOWER EXTREMITY

GENERAL HINTS ON DISSECTING

The point which the authors of this book wish to impress most strongly upon the student is that in dissecting the human body he is about to make a complete and systematic investigation for himself, and that he will reap three separate and distinct advantages from the process.

Firstly, he will learn to observe and record things as they really are.

Secondly, he will learn the structure of the human body, in curing the ills of which his life will probably be spent.

Thirdly, he will acquire a technical skill in the use of several instruments, and, if he is wise, of his pencil too, in making sketches of things as they really are.

Each of these points will bear more careful consideration.

On Observing Things as they are.—It is of the first importance that no student of nature should become a slave to his books. Let him use them by all means, but always in a sceptical and critical spirit.

Books are good servants but intolerable masters where nature is concerned, and if a student once gets into the habit of believing all that is printed, there is little hope of his ever materially advancing natural science of any kind.

Let the investigation be conducted as if it had never been done before, and when the dissection does not seem to agree with the book's description, the dissector should set down in precise words his view of the case and then talk it over with his demonstrator. Perhaps he has failed to notice something which may put a perfectly different complexion

on the matter, or perhaps he has stumbled on one of the numerous variations to which the human body is so liable; but there is always the chance, and often a good chance too, that he is right and that his way of looking at things is a happier one than that followed in the orthodox descriptions which have been handed down from past generations.

In the present work many new ways of looking at things have been introduced; many of these are the results of the writers' own experience of a large number of bodies, but many have in the first instance been pointed out by observant students who had eyes to see things as they are and patience to put what they saw into definite language.

There is no doubt that in this book, as in all others, some of the descriptions are artificial or inaccurate or might be better expressed. Let the student look out for these and correct them. Above all, let him try to make his knowledge a living knowledge of things as they are, instead of a dead knowledge of what other people have said about them.

On Learning the Structure of the Body.—In the succeeding pages the authors have tried continually to bear in mind that they are writing a guide for future medical practitioners, and that it is a practical guide for the dissecting-room. It therefore contains, as far as is possible, only statements which may be verified or disproved by the student with the means at hand in the anatomical department. Microscopical Anatomy has been left for the Histological Laboratory, while many things of great medical importance, such as the nerve paths of the spinal cord and brain, which have been discovered by physiological, embryological, and pathological methods, cannot be demonstrated in the dissecting-room.

These must be learnt from the systematic treatises on Anatomy.

Hardly any of the body is now beyond the reach of the surgeon's knife, and the modern surgeon may find himself

at a moment's notice in any part of it; hence a working knowledge of the whole body must be gained. How to provide it in the limited time at the student's disposal is the problem which Anatomy teachers have to solve.

The more experienced examiners are now laying less stress on a knowledge of the exact attachment of every muscle and the course and ramifications of the smaller arteries, but they are demanding that the student should be able to find quickly and surely all the important structures of the body and should be able to recognise them when they are only partly exposed. This means that the main geography or topography of the body must be carefully studied and no chance missed of looking at a dissection, whether it be the student's own or another's. Let a due sense of proportion always be observed; the big things are usually the most important. Get a good knowledge of where these are to be met, and the smaller things will follow in due course.

In every class of students a certain number will not be content with finding out where things are and what they are like; they will want to know why they are so.

This will lead them into the fascinating and highly contentious study of morphology, though, accurately speaking, this term is misleading, and simply means a study of form.

It is with real sorrow that the authors feel bound to advise medical students not to give up much time to this delightful study. They cannot do justice to it in the short time which is allowed for human anatomy in the ordinary curriculum, and are only likely to come to the ground between the two stools of topography and morphology. Human morphology is not essential to a medical education, though it may be taken up with advantage later on as an honours subject.

On the Art of Dissecting.—It is often said nowadays that the art of dissecting is dead, and it is also said that the good dissector makes a bad surgeon.

It is perfectly true that we seldom see now the elaborate dissections which prosectors in the old days used to prepare for the Anatomy lectures, but the reason for this is not so much that the necessary skill is absent as that the necessary time cannot be given. Students cannot now spare one, two, or three days, as they used, to prepare the subject of one lecture; nor is it really necessary that they should, for, when the skin is removed and the part under discussion exposed, the modern Anatomy lecturer often prefers to display, with a sweep or two of his knife, the various structures lying in their real positions among the surrounding cellular tissue; explaining to his class, as he does so, the different landmarks he is using.

The old idea of dissecting was to remove every particle of cellular tissue, or to condense it into fascial planes often of purely artificial production; by so doing all the other structures were left, perfectly cleaned, in all sorts of strange relationships to one another. The more rational method is to do anything that is necessary to enable the dissector to see what the various structures look like and how they are placed in regard to neighbouring structures, so that he shall have little difficulty in finding or avoiding them in the living body as they lie embedded in the surrounding cellular tissue.

To do this it is by no means always desirable to clear away all the tissue which surrounds them; it is better to leave patches here and there to keep them in place.

Then remember that the deeper the dissection goes the more will the superficial structures become displaced, and for this reason it is most desirable to get into the way of making a rough sketch of the superficial things as they lie before

they are interfered with. A good big note-book should be kept, together with a box of coloured pencils, and a pair of compasses for recording sizes and distances accurately. The note-book, of course, will get disgracefully dirty, but that is quite a small matter; the work, too, takes time, and is at first laborious and difficult, but in no other way are the details impressed on the memory so accurately or is the eye attracted by points which would otherwise escape notice. Moreover, when once the superficial structures have been drawn they may be reflected and replaced in their normal positions at will. It is not always necessary to clean the whole surface of a large muscle; its origin and insertion must be definitely determined, the general direction of its fibres noted, and the point of entry of its nerve or nerves found, but a perfect museum specimen of it cannot be hoped for.

When once a muscle has been sketched it may safely be cut and its deep surface and relations examined.

In making a deep dissection one of the greatest difficulties is to prevent the more superficial arteries and nerves being cut by that part of the knife-blade which is near the handle while the dissector's attention is concentrated on the point. To avoid this one of the writers has arranged that each of his students shall have several of his knives specially blunted to within a quarter of an inch of the point. This means that there is only a quarter of an inch of edge to look after, and the damage likely to be done to superficial parts is trifling.

The reason why many students make such poor work of their dissecting is that they never have a sharp knife. A knife which is really sharp will, after an hour's hard dissecting, be quite dull. Every dissector should have his own strop, on which he should strop his knife every ten minutes, and when this fails to bring up the edge the hone must be used. The writer has found the carburundum hones most

valuable, as a good edge is so quickly obtained; but, whatever be used, the knife must be kept quite flat and the attention concentrated on getting the point and its neighbouring part sharp.

One or two knives in each case must be kept sharp all along the blade for removing the skin. In doing this try to plan the incisions in such a way as to give as large a flap as possible. The reason for this is that small flaps shrink so much, and there is no covering which preserves a dissection as well as its own skin. Make the skin incisions boldly and cleanly, watching carefully the thickness of the skin and noticing the first sign of subcutaneous fat. As soon as this is seen the incision is deep enough. In reflecting the skin pick up an angle of the flap with good broad-pointed forceps, and do not attempt to use the delicate pointed instruments with which earth-worms were dissected. Raise the flap with even sweeps, always keeping a steady traction upon it with the left hand; indeed, when once enough of the flap is raised to grasp with the fingers, the forceps may be discarded with advantage. Keep the knife close to the skin, but try not to buttonhole it; the most superficial layer of the fat is where the knife-edge should be.

Notice carefully the thickness of the skin in different regions of the body; the knowledge will be very valuable afterwards in operating.

Never injure the epidermis in any way, since, wherever it is denuded, the skin will dry up in spite of any artificial covering.

Scissors are occasionally, though not very often, used in dissecting. Two pairs are a great advantage in a case, one fine and one coarse. The coarse pair should have very strong short blades and long strong handles; they will then cut through thin plates of bone with great ease.

Hooks for holding things out of the way are never

numerous enough. The writer makes them as he needs them of thick bent pins and fine waxed string. When two dissectors are working on one part, one of them can help the other greatly by retracting parts with a piece of copper-wire bent into a hook at its end.

Probes and seekers are indispensable and should be of different sizes. The dissector who takes an interest in the technical part of his work will find all sorts of homely articles, such as knitting-needles, crotchet-hooks, &c., gradually adding themselves to his box of apparatus, and a use for each one will constantly turn up from time to time.

Saws, chisels, and bone forceps of different patterns are provided in most dissecting-rooms, though, unfortunately, demonstrators do not always see that these are numerous enough or that they are replaced as they are worn out or broken. In the subsequent pages special attention is paid to the patterns which are most useful in different dissections.

Finally, the education of the sense of touch is most important; structures may often be felt long before they are seen, and it is wonderful how easily a man with trained fingers will pick out the different vessels, nerves, and muscles in a dissection which he is not even looking at. The practice of finding the different parts of a dissection by touch alone is an amusing and very instructive exercise and lends a pleasant variety to the monotony of continual dissection.

Whether dissecting is a bad training for a modern surgeon is a debatable point. In the old days of rapid amputations and orthodox incisions it no doubt often induced men to make three cuts where there should have been one, but in modern surgery the scalpel is used nearly as much and quite as delicately as in the dissecting-room; there is, however, one essential difference in the way in which it is used. On the living body the parts are exposed and cleaned by a series

of cuts, while on the dead body the anatomist often uses his knife to scrape things clean, or turns it round and uses the back of it to tear with. It is quite possible to do good dissecting without any tearing or scraping, and if the student makes up his mind to do this there is little doubt that his technical work will be a valuable training for him.

PRACTICAL ANATOMY

VOLUME I

HEAD AND NECK

The dissection of the head and neck should be begun as soon as the body is brought into the room. First fill the mouth and nostrils with tow or cotton wool soaked in spirit and water with which some glycerine is mixed. As a rule, it is not necessary to sew up the mouth in bodies preserved with formalin.

Then wrap up the front of the face in an oiled cloth or gutta-percha tissue, bandaging it securely on the outside. During the first seven days, while the body is on its face, the back of the scalp, together with the deeper parts of the back of the neck and trunk, and the spinal cord should be dissected. If, when this is finished, the other dissectors are not ready to have the body turned on to its back, the dissectors of the head and neck may go on with the dissection of the scalp (p. 46) or the pinna (p. 56).

THE DISSECTION OF THE BACK OF THE SCALP

Define the external occipital protuberance, and from it make a vertical incision upwards for about a hand's-breadth (*i.e.* three inches). From the top of this make another outwards to just above the top of the pinna. While this is being done, the dissectors of the upper extremity are making an incision outwards from the external occipital protuberance

along the superior curved line, and are exposing the trapezius muscle. Reflect the flap of skin 1, 2, 3 (Fig. 1) outwards.

Take a point one-third of the way from the external occipital protuberance to the tip of the mastoid process, that is to say, about an inch and a half from the former point. Here the great occipital nerve and the occipital artery enter

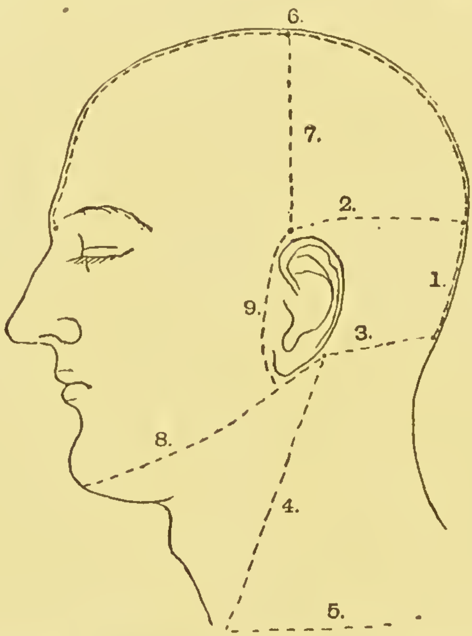


Fig. 1.—Skin Incisions for the Dissection of the Head and Neck.

the scalp, and will be found with two or three lymph nodes lying close to them though on a more superficial plane.

The *great occipital nerve* [N. occipitalis major] is the internal branch of the posterior primary division of the second cervical nerve. It should be traced upwards on the exposed area of the scalp, and then left to be reviewed when the scalp as a whole is considered.

The *occipital artery* [A. occipitalis] usually divides into inner and outer branches (rami occipitales). If the mastoid foramen is localised, by referring to a dried skull, a small

mastoid branch (ramus meningeus) is often found passing through to the dura mater.

The *occipital lymph nodes* [lymphoglandulæ occipitales] are important, since they are so often the site of abscesses, especially in neglected children.

The *third occipital nerve* [N. occipitalis tertius] should be looked for between the point at which the great occipital was

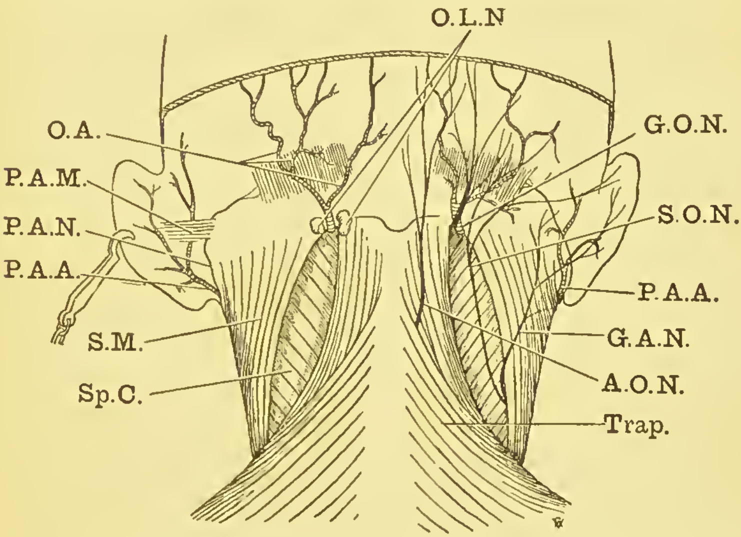


FIG. 2.—DISSECTION OF OCCIPITAL REGION.

O.A. Occipital Artery. *P.A.M.* Posterior Auricular Muscle. *P.A.N.* Posterior Auricular Nerve. *P.A.A.* Posterior Auricular Artery. *S.M.* Sterno-mastoid Muscle. *O.L.N.* Occipital Lymphatic Nodes. *Sp.C.* Splenius Capitis. *G.O.N.* Great Occipital Nerve. *S.O.N.* Small Occipital Nerve. *G.A.N.* Great Auricular Nerve. *A.O.N.* Third Occipital Nerve. *Trap.* Trapezius.

found and the mid line. It is the internal (medial) branch of the posterior primary division of the third cervical nerve.

Occasionally the *suboccipital nerve* [N. suboccipitalis] supplies an area on the scalp just external to that supplied by the great occipital. It is the posterior primary division of the first cervical nerve.

The *posterior belly of the occipito-frontalis muscle* [M occipitalis] should be looked for rising just above the outer

two-thirds of the superior curved line of the occipital bone. Notice that its fibres are only about an inch long, so that its action must be very slight.

It is supplied by the posterior auricular branch of the facial nerve, which will be exposed later, or may, if time allows, be looked for now (p. 50).

THE SPINAL REGION FROM BEHIND

As soon as the dissectors of the upper extremity have cleaned the upper part of the trapezius, the higher part of the posterior triangle of the neck should be defined by cleaning the edge of the muscle carefully, and then following the posterior edge of the sterno-mastoid muscle downwards for a couple of inches.

In doing this notice that the sterno-mastoid is inserted into the outer two-thirds of the superior occipital curved line as well as into the mastoid process, and look very carefully for the *small occipital nerve* [N. occipitalis minor] which runs up along the posterior border of this muscle. The floor of the posterior triangle is very narrow here, and is formed by the *splenius capitis*, the fibres of which run upwards and outwards (see Fig. 2).

The outline of the upper part of this triangle will be interfered with by the subsequent dissection, so that it is important to get a clear mental picture of it now.

If possible, a sketch of the dissection at this stage should be made, as it is very difficult to dissect the whole of the triangle with the body either on its face or on its back.

As soon as the arm dissectors have finished their two superficial layers of muscles, the deeper back muscles and the posterior primary divisions of the spinal nerves should be examined. Before beginning the dissection of the muscles notice that the dissectors of the upper extremity have been asked to leave intact at least two posterior cutaneous nerves,

preferably the second and eighth thoracic. Be careful not to cut these.

The *Serratus Posticus Sheet* joins the spines of the vertebræ to the ribs. As a rule, only the upper and lower parts of this sheet persist in man.

The *Serratus Posticus Superior* is the upper part, and rises from the spines of the last cervical and upper two or three thoracic vertebræ as well as from the supraspinous ligaments joining these spines. The muscle runs outwards and downwards to the ribs, from the second to the fifth inclusive, a little outside the angles.

The *Serratus Posticus Inferior* is the lower part, and rises from the lumbar fascia over the loins rather than directly from the vertebral spines. The muscle runs upwards and outwards, and is inserted into the lower four ribs just outside the margin of the erector spinæ.

Reflect both these muscles and try to find a delicate nerve plexus derived from the intercostals by which they are supplied.

The *Splenius Sheet* rises from the lower part of the ligamentum nuchæ as high as the level of the third cervical vertebra, the upper four or five thoracic spines and the supraspinous ligament joining their tips. It is inserted into the outer two-thirds of the superior curved line of the occipital bone and the outer surface of the mastoid process deep to the sterno-mastoid. As this insertion is hidden by that of the sterno-mastoid, it is necessary, in order to see it, to cut through the tendinous insertion of the latter muscle along the superior curved line for about two-thirds of its breadth. Be very careful, however, not to cut through those anterior fibres of the sterno-mastoid which are attached to the mastoid process. This part, which is inserted into the head, is called the *splenius capitis*, and the muscles of the two sides diverge, leaving a V-shaped gap, like the opening of a waistcoat, in which the complexus is exposed.

When the sheet is too broad for it all to gain an insertion

into the skull, the lower part is inserted into the posterior tubercles of the transverse processes of those cervical vertebræ which are nearest, namely, the upper one, two or three, and this part, when present, is known as the *splenius colli* [M. splenius cervicis].

The whole sheet is supplied by the posterior primary divisions of the spinal nerves in relation with it. Notice that the great occipital nerve does not pierce the splenius, though the third occipital does.

The *Erector Spinæ* [M. sacrospinalis] is one great mass below rising from the posterior part of the inner surface of the iliac crest, from the posterior sacro-iliac ligaments, the posterior surface of the sacrum and the sacral, lumbar and lower thoracic spines. No useful purpose is served by learning the whole of the insertions, since they are very variable and of little or no practical importance.

It will be noticed that the lower part of the mass is covered by a strong aponeurosis—the *posterior lamella of the lumbar fascia*—[F. lumbodorsalis], but this cannot be cleaned away satisfactorily since the muscle rises from its deep surface. Running upwards, the mass divides into three columns, of which the outer is known as the *ilio-costalis* [M. ilio-costalis lumborum], and is inserted into the lower six ribs at their angles.

Rising just internal to these insertions are other tendons which run up to the angles of the upper six ribs and form the *accessorius* [M. ilio-costalis dorsi]. This in its turn is succeeded by the *cervicalis ascendens*, rising internal to the accessorius from the upper six ribs, and being inserted into the posterior tubercles of some of the lower cervical transverse processes.

The middle column of the erector spinæ is the largest, and is called the *longissimus dorsi*, while the most internal is the *spinalis dorsi*. This latter is so called because it is entirely attached to spines; it is a narrow muscle rising from the lumbar and lower thoracic, and being inserted into the

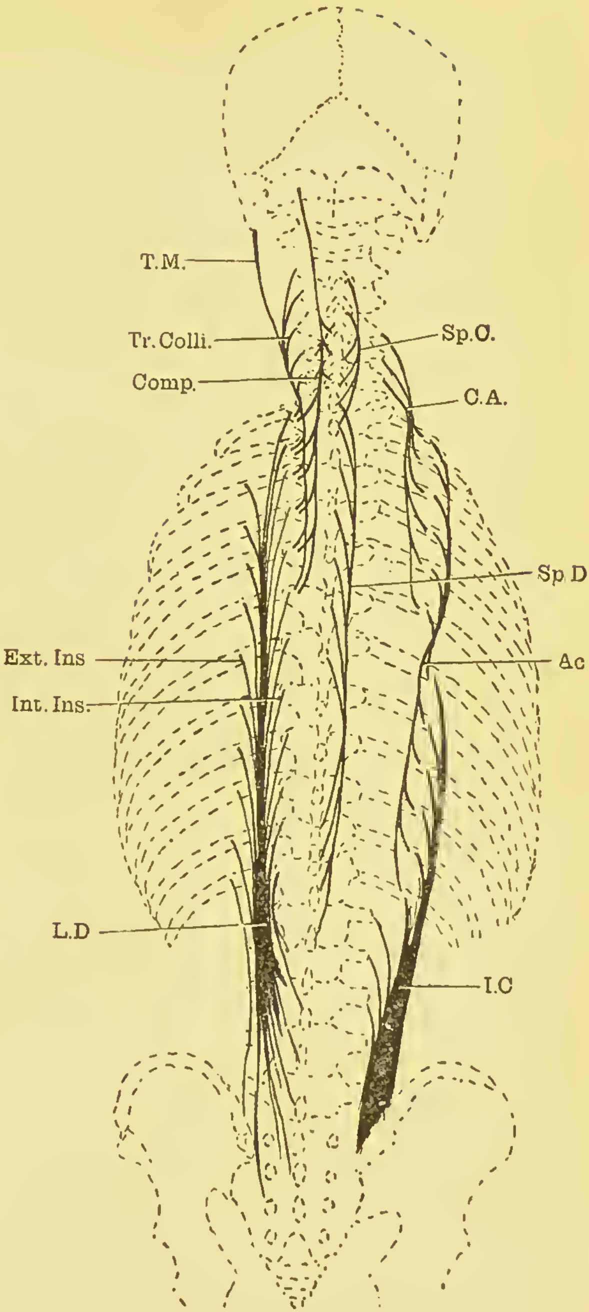


FIG. 3. — DIAGRAM OF THE ERECTOR SPINÆ MUSCLES. THE MIDDLE OF THE THREE DIVISIONS IS OMITTED ON THE RIGHT SIDE AND PUT IN ALONE ON THE LEFT.

I.C. Ilio-costalis.
Ac. Accessorius.
C.A. Cervicalis Ascendens.
Sp.D. Spinalis Dorsi.
Sp.C. Spinalis Colli.
L.D. Longissimus Dorsi.
Ext. Ins. External series of Insertions.
Int. Ins. Internal series of Insertions.
T.M. Trachelo-mastoid.
Tr. Colli. Transversalis Colli.
Comp. Complexus.

upper thoracic spines. It is not, as a rule, continued into the neck, and is only imperfectly separated from the longissimus dorsi and the subjacent semispinalis.

The *Longissimus Dorsi* is the part of the erector spinæ which is left after the ilio-costalis and spinalis divisions have been separated. Draw it inward and a series of insertions into the ribs between the tubercles and angles will be seen, while on drawing it outward a series of slips into the transverse processes of the thoracic vertebræ will be easily traced. This muscle, therefore, has an external and internal set of insertions. As soon as the three columns of the erector spinæ have been localised, and before anything has been cut away, *the posterior primary divisions of the thoracic nerves* should be traced.

With the exception of the first cervical, the last two sacral and the coccygeal nerves, each posterior primary division divides into an external and an internal branch, and in the thoracic region the longissimus dorsi lies between these branches, so that the outer ones must be sought between the outer and middle columns of the erector spinæ, and the inner branches between the middle and inner columns.

In the upper six thoracic nerves the internal branch becomes cutaneous, while in the lower six it is the external, though the transition is seldom a very sharp one, since in the mid-thoracic region it is often found that both internal and external branches supply the skin.

It is for this reason that the dissectors of the upper extremity were asked to leave intact the second and eighth thoracic posterior cutaneous branches. In tracing the internal branch of the second thoracic nerve (see Fig. 4), notice that it does not pass quite close to the longissimus dorsi and its upward continuations, the complexus and transversalis sheet, because there are some rather long oblique muscular slips which rise from the transverse processes and are inserted into spinous processes some distance higher up. These

form the *semispinalis*, and are only found in the upper thoracic (semispinalis dorsi) and cervical regions (semispinalis colli) [M. semispinalis cervicis].

On the inner side of the second and following internal

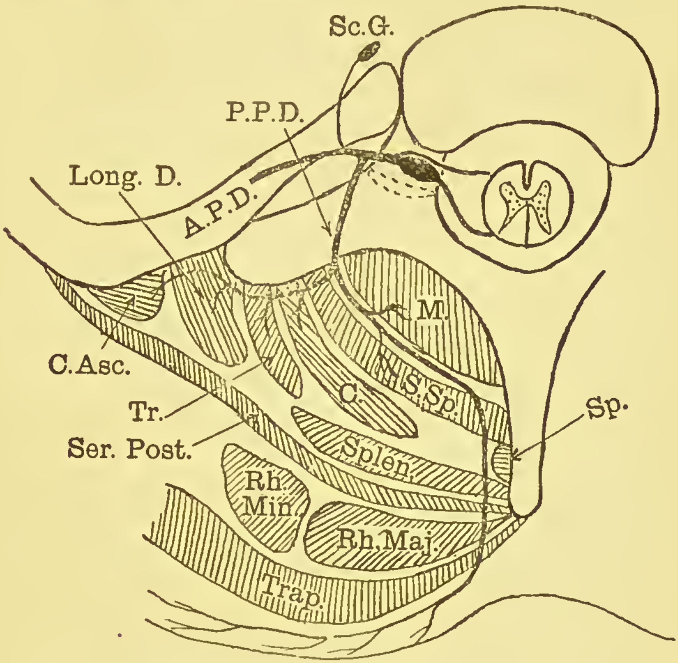


Fig. 4.—Diagram of the Posterior Primary Division of the Second Thoracic Nerve.

Sc.G. Sympathetic Ganglion. *P.P.D.* Posterior Primary Division. *A.P.D.* Anterior Primary Division. *C.Asc.* Cervicalis Ascendens. *Long. D.* Longissimus Dorsi. *Tr.* Transversalis Colli and Trachelo-mastoid. *Sp.* Spinalis. *C.* Complexus. *S.Sp.* Semispinalis. *M.* Multifidus. *Splen.* Splenius. *Ser. Post.* Serratus Posticus. *Rh.Min.* Rhomboideus Minor. *Rh.Maj.* Rhomboideus Major. *Trap.* Trapezius.

branches, and deep to the spinalis dorsi or inner column of the erector spinæ, is the *multifidus spinæ*, a muscle which also runs from the transverse to spinous processes, but has shorter fibres than those of the semispinalis. Unlike the last muscle, it is more massive in the lower part of the spinal region than in the upper.

If the cutaneous branch of the eighth thoracic nerve be

now followed it will serve as a type of the course of the cxternal branches from the seventh to the twelfth.

In the upper three lumbar nerves the external branches continue to supply the skin as they do in the lower thoracic region, but these branches pierce the ilio-costalis and appear

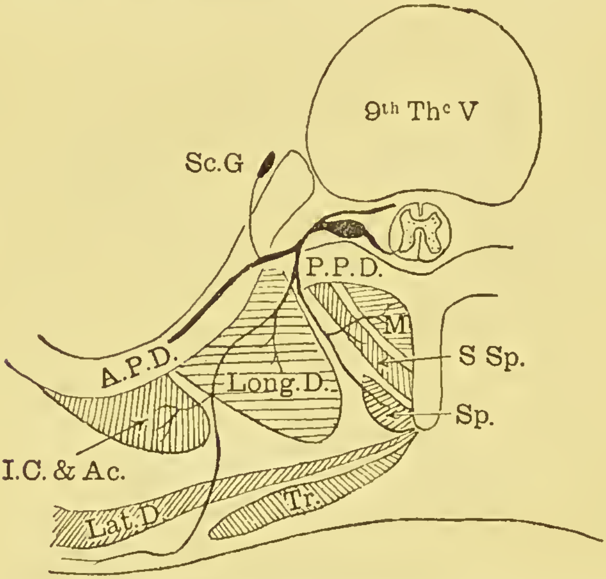


Fig. 5.—Diagram of the Posterior Primary Division of the Eighth Thoracic Nerve.

A.P.D. Anterior Primary Division. *P.P.D.* Posterior Primary Division. *Sc.G.* Sympathetic Ganglion. *I.C. & Ac.* Ilio-costalis and Accessorius. *Long.D.* Longissimus Dorsi. *M.* Multifidus Spinæ. *S.Sp.* Semispinalis Dorsi. *Sp.* Spinalis Dorsi. *Lat.D.* Latissimus Dorsi. *Tr.* Trapezius.

at its outer border, after which thcy cross the crest of the ilium to supply the skin of the buttock.

In the lower lumbar nerves there are very few cutaneous fibres, but where they do supply skin it is by means of the internal branches.

The coursc of the sacral and coccygeal nerves will be examined by the dissectors of the lower extremity.

It must not be thought that, because either the external or internal branches of the posterior primary divisions supply

skin, they are necessarily entirely cutaneous. A good working generalisation is that the outer two columns of the erector spinæ are supplied by the external branches, while the spinalis dorsi and multifidus spinæ are supplied by the internal.

The outer column of the erector spinæ has been followed up into the neck as the cervicalis ascendens. The outer series of insertions of the longissimus dorsi is not continued into the neck at all, but the inner series is prolonged by three muscles, the trachelo-mastoid, transversalis colli, and complexus. All of these rise from the transverse processes of the upper thoracic and, higher up, from the articular processes of the lower cervical vertebræ. In addition to these the complexus very often has a few slips of origin from the lower cervical spines (see Fig. 3).

The *Trachelo-mastoid* [M. longissimus capitis] runs up from this origin to the outer side of the mastoid process, and is easily recognised as the only muscle between the splenius and the complexus. It is sometimes called the *transversalis capitis.*

The *Transversalis Colli* [M. longissimus cervicis] is inseparably blended with the last muscle at its origin, and is inserted into the posterior tubercles of most of the cervical transverse processes.

The *Complexus* [M. semispinalis capitis] runs up to the space between the superior and inferior curved lines on the occipital bone. Its inner part forms a fairly distinct muscle with a fleshy belly above and below and a central tendon; this is known as the *biventer cervicis.*

At the insertion of the outer border of the complexus look for the *occipital artery*, which passes superficial to the muscle. Close to this point the artery gives off the *arteria princeps cervicis* [ramus descendens], a branch which divides into smaller superficial and deep branches running down on the corresponding surfaces of the complexus.

The cervicalis ascendens, transversalis colli, and trachelo-

mastoid muscles should now be cut, and their nerves from the posterior primary divisions of the cervical nerves found.

The *Levator Anguli Scapulæ* [M. levator scapulæ] has been defined in its lower part by the dissectors of the upper extremity. Do not displace it more than is really necessary, as it forms a large part of the floor of the posterior triangle. It usually rises from the posterior tubercles of the upper three cervical transverse processes.

The levator anguli scapulæ should be gently drawn aside in order to examine the attachments of the *scalenus medius* and *posticus* [MM. scaleni medius et posterior]. These muscles are very closely blended at their upper attachments, but below they may be separated easily enough, since the posticus is attached to the second rib behind the attachment of the serratus magnus. Cut it through near its lower attachment, and then the upper part may be traced to the posterior tubercles of the cervical transverse processes, usually the lower three.

The scalenus medius is attached below to the first rib just behind the groove in which the subclavian artery and lower trunk of the brachial plexus lie. Above, it is attached to the posterior tubercles of most of the cervical transverse processes; most commonly to all except the first and last. Some fibres of the scalenus medius end in the fibrous backing (*Sibson's fascia*) which strengthens the dome of the pleura. When these are very distinct they are sometimes called the *scalenus pleuralis*.

The terms "origin and insertion" have been purposely avoided in describing these scalene muscles since they probably act equally well in either direction.

The middle and posterior scalenes are innervated from the anterior primary divisions of the cervical nerves, third to the seventh, but it is better to leave the search for these until later.

The six muscles which are attached to the posterior

tubercles of the transverse processes may now be reviewed. Their relative positions and approximate attachments are indicated in the accompanying table, the muscles being placed in their order from before backward.

	Cervical Trans. Processes.						
Ventral Side.	1	2	3	4	5	6	7
1. Scalenus Medius . . .							
2. Scalenus Posticus . . .							
3. Levator Ang. Scap. . . .							
4. Splenius Colli							
5. Cervicalis Ascendens . .							
6. Transversalis Colli . . .							
Dorsal Side.							

The *Posterior Primary Divisions of the Cervical Nerves* divide into external and internal branches just as the thoracic do, but the internal are of more importance, because from the second to the fifth they become cutaneous, while the sixth, seventh, and eighth cervical posterior primary divisions have no cutaneous supply at all.

Some of the cutaneous branches may possibly have been damaged by the dissector of the upper extremity in reflecting the trapezius, but the great occipital, which is the cutaneous portion of the internal branch of the second, will be easily found piercing the complexus and running upwards and outwards to join the occipital artery. A little distance below and internal to this the cutaneous branch of the third cervical nerve pierces the complexus and often communicates with the second.

When the complexus is cut the nerve may be traced between it and the semispinalis colli.

The fourth and fifth internal branches have the same

relation, but the sixth, seventh, and eighth resemble the

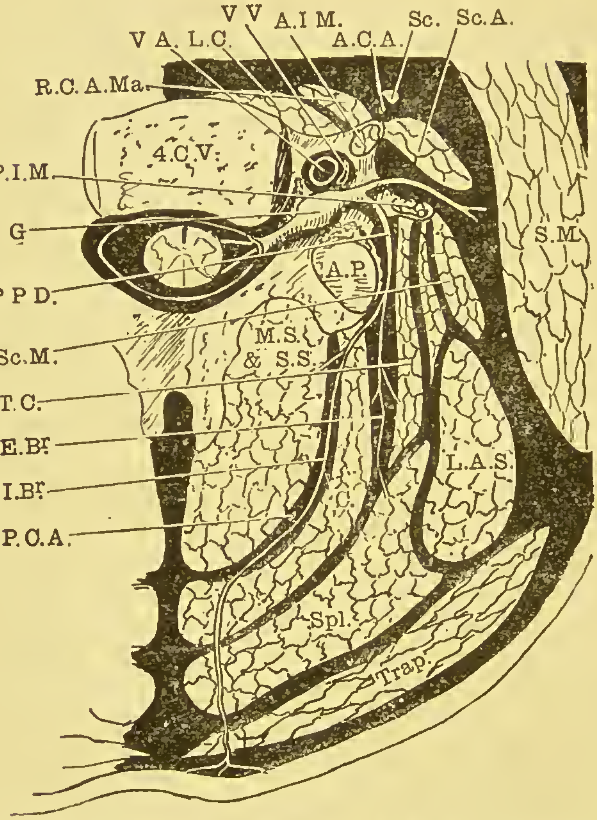


FIG. 6.—DIAGRAMMATIC SECTION THROUGH THE BACK OF THE RIGHT SIDE OF THE NECK TO EXPOSE THE COURSE OF THE POSTERIOR DIVISION OF THE FOURTH CERVICAL NERVE.

4.C.V. Body of Fourth Cervical Vertebra. *L.C.* Longus Colli. *R.C.A.Ma.* Rectus Capitis Anticus Major. *V.A.* Vertebral Artery. *V.V.* Vertebral Vein. *A.I.M.* Anterior Intertransverse Muscle. *P.I.M.* Posterior Intertransverse Muscle. *A.C.A.* Ascending Cervical Artery. *Sc.* Sympathetic. *Sc.A.* Scalenus Anticus. *S.M.* Sterno-mastoid Muscle. *G.* Posterior Root Ganglion in its Sheath. *P.P.D.* Posterior Primary Division of Fourth Cervical Nerve. *Sc.M.* Scalenus Medius. *T.C.* Transversalis Colli. *E.Br.* External Branch of Nerve. *I.Br.* Internal Branch of Nerve. *P.C.A.* Profunda Cervicis Artery. *A.P.* Articular Process. *M.S.* and *S.S.* Multifidus and Semispinalis. *C.* Complexus. *Spl.* Splenius. *L.A.S.* Levator Angnli Scapulæ. *Trap.* Trapezius.

thoracic nerves in passing between the semispinalis and the subjacent multifidus.

The external branches will be found external to the complexus, supplying the transversalis colli, trachelo-mastoid, splenius, and complexus.

At this stage it may be well to recapitulate the chief points in relation to the posterior primary divisions, leaving the first cervical and sacral nerves for subsequent examination.

1. All the posterior primary divisions of the cervical (except the first), the thoracic and lumbar nerves divide into external and internal branches, which embrace the longissimus dorsi in the trunk and the complexus in the neck. Below the fifth cervical the semispinalis is also received into the fork.

2. Both external and internal branches are muscular, although only one of them is cutaneous.

3. In the upper half of the body (as low as the sixth thoracic) the internal branches supply the skin.

4. In the lower half of the body (below the sixth thoracic) the external branches supply the skin.

5. The lower three cervical and lower two lumbar nerves give off no posterior cutaneous branches as a rule.

Superficial to the semispinalis, which ends abruptly at the spine of the axis, the *profunda cervicis artery* [A. cervicalis profunda] will be found running up to anastomose with the deep branch of the arteria princeps cervicis of the occipital already mentioned. It is a branch of the superior intercostal, itself a branch of the subclavian, and it passes back above the neck of the first rib and below the transverse process of the seventh cervical vertebra, having the multifidus and semispinalis colli internal to it and the scalenus medius external.

SUBOCCIPITAL TRIANGLE

Localise the spine of the axis where the semispinalis colli ends, and also the transverse process of the atlas about 2 inches external to, and a little above, it.

The suboccipital triangle is formed by the rectus capitis posticus major muscle internally, the obliquus superior above and externally, and the obliquus inferior below and externally.

The *Obliquus Capitis Inferior* is easily found by follow-

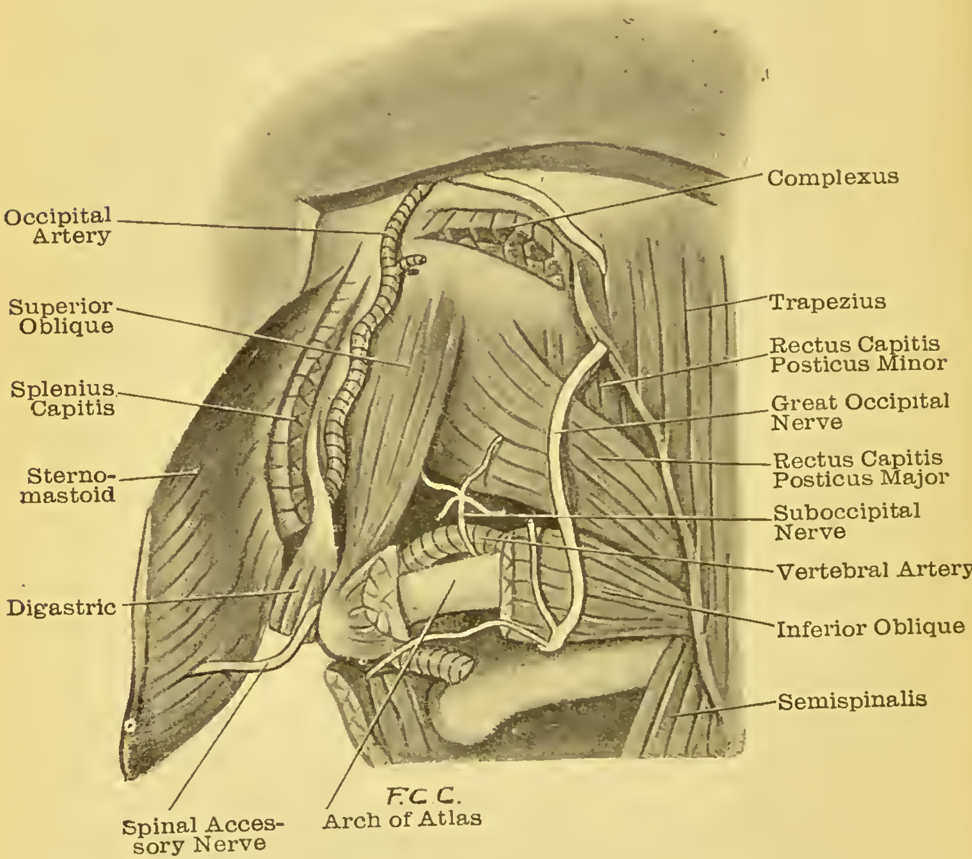


FIG. 7.—DISSECTION OF THE SUBOCCIPITAL TRIANGLE.

ing the great occipital nerve, which curves round its lower border. The muscle passes nearly horizontally from the spine of the axis to the transverse process of the atlas. In cleaning it look out very carefully for a branch of the sub-occipital nerve, which comes out of the triangle and enters it near its upper border.

The *Obliquus Capitis Superior* runs from the transverse process of the atlas to the occipital bone between the superior and inferior curved lines, and under cover of the outer edge of the complexus. Look for a twig from the suboccipital nerve near its inner border.

The *Rectus Capitis Posticus Major* [M. R. C. Posterior Major] runs from the spine of the axis to the inferior curved line of the occipital bone deep to the insertion of the obliquus superior. Its nerve, also derived from the suboccipital, enters it on its superficial surface and is of fair size (see Fig. 7).

In cleaning these muscles the *suboccipital plexus of veins*, into which the occipital vein drains, will be much in the way, and great care must be taken to find any of the twigs of the suboccipital nerve.

The upper cut end of the complexus should now be replaced in order to realise that this muscle alone forms the roof of the triangle. When this has been done it may be cut short in order to get it out of the way, and its insertion into the inner part of the space between the superior and inferior curved lines noted.

The floor of the suboccipital triangle is formed below by the posterior arch of the atlas, and above by the posterior occipito-atlantal ligament running up from it to the occipital bone.

Put a dried atlas into the relative position of that in the body and, comparing the two specimens, notice that the *vertebral artery* [A. vertebralis], in this its third part, comes through the vertebrarterial foramen, and then runs inwards just above the posterior arch, having the superior articular process of the atlas immediately in front of it. As it reaches the inner side of the process the artery pierces the posterior occipito-atlantal ligament and is then lost to view.

Now follow any of the branches of the *suboccipital nerve* [N. suboccipitalis] which have been found to the main trunk. This, which is the posterior primary division of the

first cervical nerve, will be seen coming out between the vertebral artery and the posterior arch of the atlas.

The dissection of this third stage of the vertebral artery is a deep and rather difficult one, but after the attachments of the muscles bounding the triangle have been seen these muscles may be reflected and more room thus gained.

After dividing the obliquus superior notice that the *rectus capitis lateralis*, which runs up from the transverse process of the atlas to the jugular process of the occipital bone, is just in front.

The *Rectus Capitis Posticus Minor* [M. R. C. Posterior Minor] is a small muscle, lying internal to the rectus capitis posticus major, rising from the tubercle on the back of the posterior arch of the atlas in the middle line and running up to the occipital bone a little behind the foramen magnum. It is supplied by the suboccipital nerve.

Notice that all the muscles in the suboccipital region rise below and are inserted above. If this is borne in mind, together with the fact that the head is nodded at the occipito-atlantal joint and shaken at the atlanto-axial, there will be no difficulty in thinking out the action of any of them.

EXPOSURE OF THE SPINAL CORD

Clean the muscles from the posterior surfaces of the spines and laminæ and identify the articular processes.

Notice the *dorsal spinal venous plexus* [Plexus venosi vertebrales posteriores] lying close to the neural arches of the vertebræ.

Place one or two blocks beneath the lower part of the thorax, and let the head hang well down over the edge of the table.

Make a longitudinal saw-cut through the laminæ close to the articular processes on each side, slanting the saw so that its edge is directed a little inwards.

Begin the cut in the upper lumbar region where it is most easily made, and as soon as two or three laminæ are cut through on each side raise them by dividing the ligamentum subflavum between the third and fourth lumbar laminæ.

Now fix the chain hooks firmly into the raised neural arches, and let one dissector forcibly retract them toward the head, while the other with the bone forceps and saw divides the rest, one after another. In this way it is easy to see how much cutting is required, and there is very little risk of injuring the dura mater.

With care the work may be carried right up to the atlas without injuring any of the spinal nerves. The lower lumbar and sacral laminæ may then be removed until the whole length of the spinal dura mater is exposed. This latter part of the work is, in our experience, best done with the chisel, though different manipulators find that they can work best with different implements.

The elastic *ligamenta subflava* [Ll. flava] should be examined; they join the laminæ together and end laterally at the articular processes, where they form the inner part of the capsular ligament.

In order to expose completely the dura mater, some fat and the dorsal or posterior part of the *extradural venous plexus* [plexus venosi vertebrales interni] must be cleared away. Finally, the posterior arch of the atlas should be divided on each side with bone forceps, where the vertebral artery is grooving it, and the piece carefully removed.

The next stage, after noticing the cylindrical bag which the dura mater forms, is to lay it open in its whole length from the foramen magnum to its pointed termination opposite the second or third sacral vertebra. This should be done by a median dorsal incision, but great care must be taken not to injure the delicate arachnoid which lies quite close to its deep surface. The best plan is for each dissector to take a pair of forceps and hold up the membrane after

the first tentative incision has been made, then one of them with a sharp scalpel slits it open from within.

Notice that the *spinal dura mater* shows three marked points of contrast with that within the cranium.

Firstly, it does not form the periosteum of the spinal canal as the cranial does of the skull.

Secondly, no venous spaces are found in its substance. It has, however, been noticed that an extradural plexus of

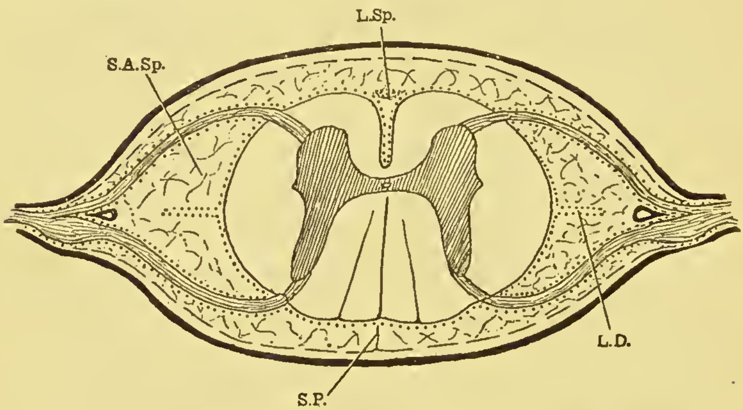


FIG. 8.—DIAGRAMMATIC SECTION THROUGH THE CORD AND ITS MEMBRANES.

The dura mater is indicated by a heavy black line, the arachnoid by an interrupted fine line, and the pia mater by a dotted line. *L.D.* Ligamentum Denticulatum. *S.P.* Septum Posticum. *L.Sp.* Linea Splendens. *S.A.Sp.* Subarachnoid Space.

veins surrounds it, and this is probably the spinal equivalent of the intracranial blood sinuses. In this case the spinal dura mater corresponds to the inner or cerebral layer of the dura mater of the skull, while the periosteum of the spinal canal represents the cranial or outer layer of that membrane.

The third point of contrast is, that there are no internal processes like the tentorium or falx in the cranium.

On opening the dura mater the *subdural space* [cavum subdurale] is exposed; this is very small, and during life contains hardly any fluid. It extends for some 26 inches

from the foramen magnum to the second or third sacral vertebra.

At its lower pointed end the dura mater blends with the filum terminale of the cord, which is continued down for about 2 inches to the posterior surface of the coccyx, thus anchoring the apex of the dural sac (see Fig. 11).

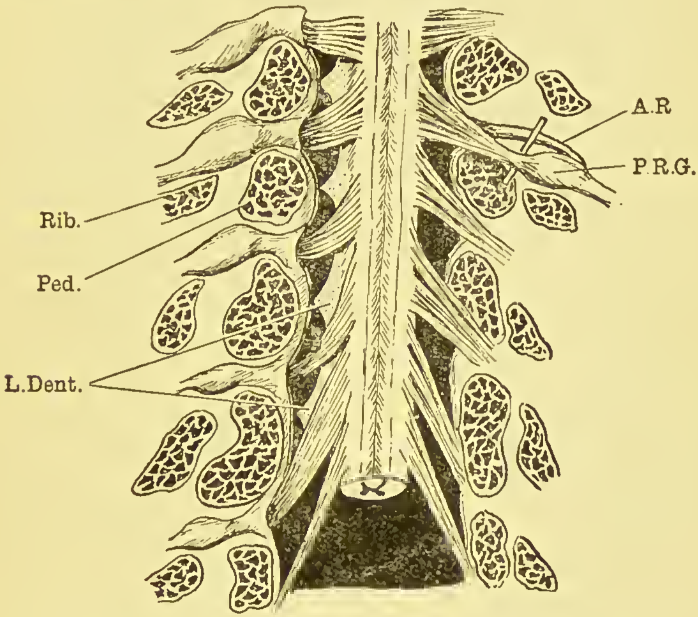


FIG. 9.—DISSECTION OF THE SPINAL CORD IN THE UPPER THORACIC REGION FROM BEHIND.

Ped. Pedicle. *L.Dent.* Ligamentum Denticulatum. *A.R.* Anterior Nerve Root. *P.R.G.* Posterior Root Ganglion.

Where the spinal nerves leave the dura mater they have separate sleeves for the anterior and posterior roots. Open up one or two of the intervertebral foramina by cutting away the articular processes with a chisel or forceps (parrot-bill forceps are very useful here if available); this will expose the ganglia on the posterior nerve roots which lie in the foramina. Each of these nerve roots is surrounded by a sleeve of the dura mater which becomes the sheath of

the root just before the ganglion is reached. Slit one open to verify this. When looked at from outside the dura mater the sleeves on the anterior and posterior roots look like one sleeve, because they are connected by fibrous tissue.

The *Arachnoid* [arachnoidea spinalis] is a very delicate transparent membrane lying quite close to the dura mater, and often thickened in old subjects by delicate calcified plates. It absolutely cuts off the subdural space from the *subarachnoid* [cavum subarachnoidale] which lies inside it, and contains the cerebro-spinal fluid (see Fig. 8). Pick up the arachnoid and open it as the dura mater was opened, only keep a little to one side of the mid line. Since the arachnoid lies so close to the dura mater, it is obvious that the lower limit of the subarachnoid space will be at practically the same level as that of the subdural already determined. Notice that, on reflecting the arachnoid, its subarachnoid space contains delicate trabeculæ which become massed into a definite septum in the mid line behind. This is the *septum posticum*, and a knowledge of its presence prompted the advice that the arachnoid should be divided a little to one side of the middle line.

The *Pia Mater Spinalis* is rather thicker than that of the brain, and closely invests the cord. Between the anterior and posterior roots of the spinal nerves look for the *ligamenta denticulata*, which are lateral sheets of the pia mater running out to join the dura mater on each side. Near the latter the sheets end in twenty-one pairs of processes, giving each the appearance of the edge of a saw, the points being attached to the dura mater, while the back of the saw is turned toward the cord. They obviously keep the cord in the middle of the subarachnoid space (see Fig. 9).

In the upper part of the dissection look very carefully for the posterior root of the first cervical nerve; it is sometimes absent altogether, and when present is very small. It is in marked contrast to the posterior root of the second, which is

very large. This is not surprising when it is remembered how small the cutaneous supply of the first cervical nerve is

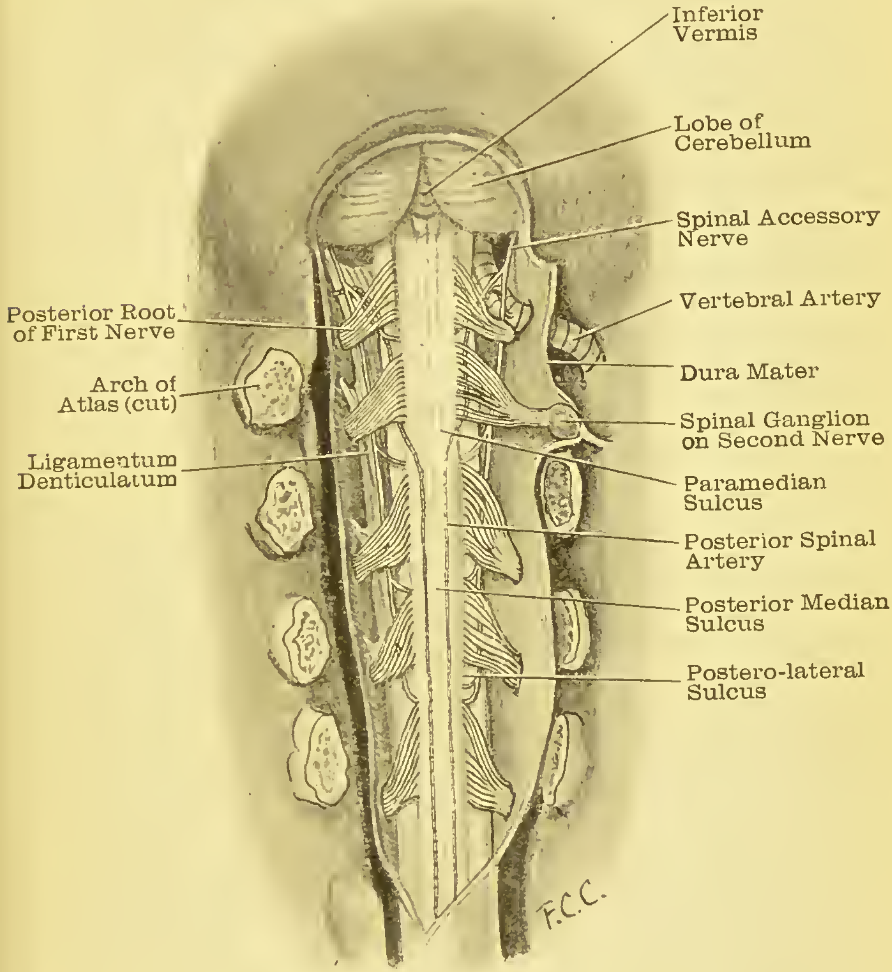


FIG. 10.—DISSECTION OF THE CERVICAL REGION OF THE SPINAL CORD.

(In this specimen the posterior root of the first nerve was unusually large.)

and how often it is non-existent, while from the second the back of the scalp is largely supplied.

In front of, deep to, the posterior roots of the upper three

or four cervical nerves, the *spinal part of the spinal accessory* [ramus internus nervi accessorii] will be seen running up to the foramen magnum and receiving twigs from the lateral part of the cord. As the nerve ascends it will be seen to lie between the posterior nerve roots and the ligamentum denticulatum (see Fig. 10).

Now trace the *vertebral artery* from where it was left in the dissection of the suboccipital region. The posterior arch of the atlas and posterior occipito-atlantal ligament have been removed, so that the artery may be followed easily to the outer surface of the dura mater through which it disappears after giving off a *posterior meningeal branch* [ramus meningeus], which, like all the other meningeal arteries, is extradural.

On turning to the inner side of the opened dura mater the artery is not seen coming through until the ligamentum denticulatum is cut away. Then it is seen to have pierced the dura mater obliquely, and to have reflected a good deal of the deep fibrous layers of the latter on to its own coats.

As soon as the vertebral artery has pierced the dura mater, it gives off the *posterior spinal branch* [A. spinalis posterior], which runs downwards, often being in front of one or two spinal posterior roots, but later on passing between two of them to gain its permanent position behind the posterior roots.

Now take a general survey of the *spinal cord from behind*, and notice that it begins at the foramen magnum and ends opposite the lower border of the first lumbar vertebra.

In an adult male it measures about eighteen inches.

In the cervical and lower thoracic regions it thickens to form the *cervical* and *lumbar enlargements* [intumescentia cervicalis et lumbalis], where the nerves for the great limb plexuses come off.

Below it tapers to an apex forming the *conus medullaris*, from which the intradural part of the *filum terminale* runs

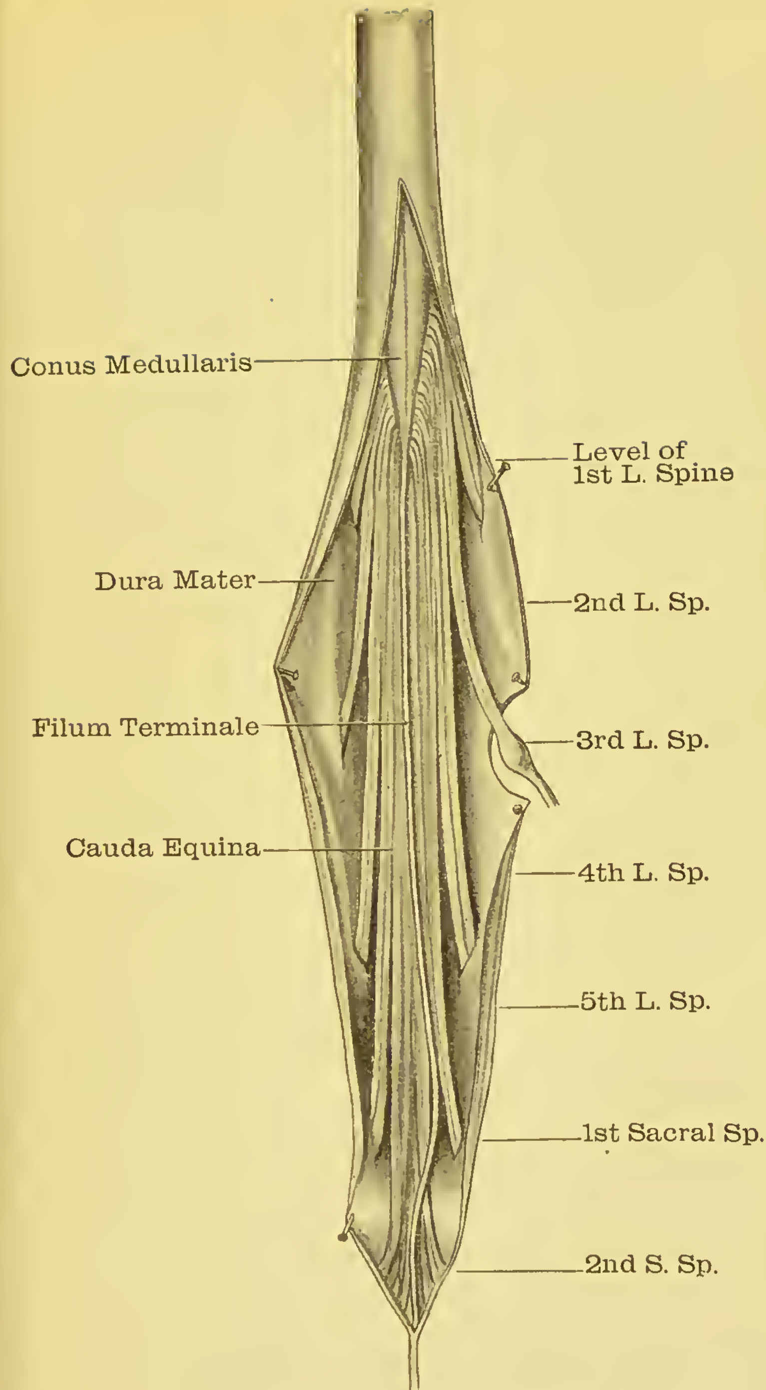


FIG. 11.—LOWER END OF THE DURA MATER LAID OPEN TO SHOW THE CAUDA EQUINA.

down to the apex of the dural sheath, already localised at the level of the second or third sacral vertebra. The conus itself is opposite the twelfth thoracic spine. The filum terminale is hidden by the great mass of nerve roots which are running down from the lumbar enlargement to the openings in the dural sheath opposite their respective intervertebral foramina. It is important to notice that, no matter how long a posterior root may be, its ganglion always lies in the intervertebral foramen. This mass, from its likeness to a horse's tail, is known as the *cauda equina*, and the filum terminale may be distinguished from any of the surrounding nerves by its glistening appearance and median position.

The intradural part of the filum measures about eight inches, and, as the extradural has already been found to measure two, the total length of the structure is ten inches.

Now remove the spinal cord by cutting through all the nerve roots and dividing it at the level of the foramen magnum; the filum terminale will be divided among the nerves of the cauda equina.

Directions for the subsequent examination of the spinal cord are given now, though it may be found convenient to put the cord away in the brain jar for the present and to go on to the spinal canal (see p. 31).

Examination of the Spinal Cord

Looked at from in front, the *linea splendens*, within the substance of which the single *anterior spinal artery* [A. spinalis anterior] is embedded, is seen in the mid line. This is a glistening thickening of the pia mater in front of the anterior median fissure of the cord.

In the upper part the formation of the artery by the union of two branches, one from each vertebral, may be made out.

Cut through the linea splendens exactly in the mid ventral line and gently insert a seeker. This will open up

the antero-median fissure [Fissura mediana anterior] of the cord into which the deeper layer of the pia mater is reflected.

A little distance to each side of the mid ventral line is the *antero-lateral sulcus* [S. lateralis anterior] where the anterior nerve roots emerge. Apart from the exit of the nerve roots the sulcus would hardly be noticeable.

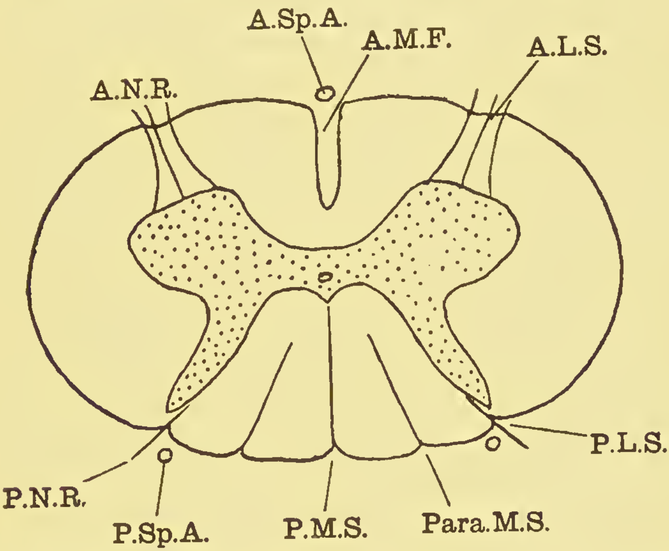


FIG. 12.—DIAGRAMMATIC SECTION OF THE SPINAL CORD TO SHOW THE MARKINGS ON ITS SURFACE.

A.M.F. Antero-median Fissure. *A.Sp.A.* Anterior Spinal Artery. *A.L.S.* Antero-lateral Sulcus. *A.N.R.* Anterior Nerve Roots. *P.M.S.* Postero-median Sulcus. *P.L.S.* Postero-lateral Sulcus. *P.N.R.* Posterior Nerve Root. *P.Sp.A.* Posterior Spinal Artery. *Para.M.S.* Paramedian Sulcus.

Working round to the back, the posterior nerve roots are seen entering the *postero-lateral sulcus* [S. lateralis posterior], which is rather better marked than the antero-lateral, and the bundles of posterior roots lie in a single line while those of the anterior form a double line. It is, however, quite difficult to distinguish the two roots in this way.

Just behind the posterior roots are the *posterior spinal arteries*, of which there are two, one on either side. They

begin as branches of the vertebral. These anterior and posterior spinal arteries are only the main stems of a delicate peripheral arterial plexus which is reinforced along the nerve roots by delicate radicular branches given off from the vertebral, intercostal and first lumbar arteries. This plexus needs very fine injecting to show it up, and is accompanied by an equally delicate peripheral venous plexus draining into *radicular veins.*

In the mid line behind is the *posterior median sulcus* [sulcus medianus posterior], which, unlike the anterior, marks a mere septum, and has no reduplication of pia mater in it. Between it and the postero-lateral sulcus look for a delicate linear depression, best marked in the upper part of the cord, called the *paramedian sulcus* [sulcus intermedius posterior], and indicating the separation of the columns of Goll and Burdach in the white matter of the cord.

In distinguishing the front from the back of a spinal cord removed from the body, the following points should be specially attended to :—

1. If the spinal nerves are long enough to show the ganglia on the posterior roots, the matter is settled at once.
2. The linea splendens on the front of the cord.
3. The single anterior spinal and double posterior spinal arteries.
4. The posterior nerve roots coming off in a single line from the postero-lateral sulcus, while the anterior form a double line. This needs very close observation.

Now make a transverse section of the cord in the mid thoracic region; this is its narrowest part, and here it is practically circular, having a diameter of about 10 mm. Notice that the grey matter is enclosed in the white and has the appearance of an H, the crossbar of which is nearer the front of the cord.

This crossbar is the *grey commissure* [C. anterior grisea], and is divided into anterior and posterior parts by

the *central canal of the cord* only just visible to the naked eye.

The uprights of the H form the *anterior* and *posterior horns* [columna anterior and posterior], of which the anterior are shorter and broader than the posterior.

The *posterior horns* diverge somewhat and very nearly reach the surface of the cord at the postero-lateral sulcus. At their tips they have a translucent appearance, due to the presence of the *substantia gelatinosa of Rolando*, while at their bases they are rather broadened on their medial aspect, close to the grey commissure, by a column of cells best marked in this region and known as the *posterior vesicular* or *Clarke's column* [nucleus dorsalis].

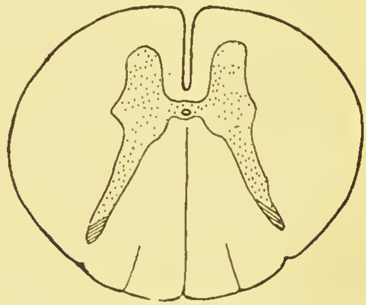


FIG. 13.—DIAGRAMMATIC SECTION THROUGH THE SPINAL CORD IN THE THORACIC REGION.

Notice that the anterior horns do not nearly reach the surface of the cord, and that, although they are distinctly broader than the posterior, they are not more than twice as broad.

The white matter surrounds the grey, and is mapped out into various tracts, which do not concern us here, since they are not visible to the naked eye and depend on embryological, pathological, and experimental evidence for their determination.

The *anterior* and *posterior median fissures*, however, are visible, and it will be noticed how much broader though shallower the former is than the latter.

On looking at the anterior median fissure carefully, the reduplication of the pia mater into it is evident. At its bottom it does not reach the grey commissure, but leaves room for the white matter to communicate across the mid line, thus forming the *white commissure*.

The posterior median fissure, on the other hand, though much narrower, reaches the grey commissure.

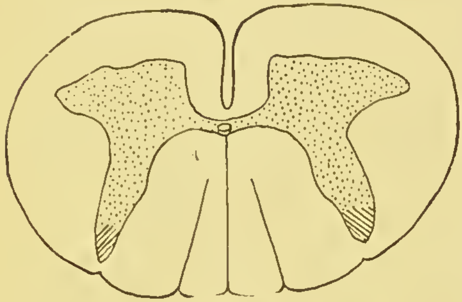


Fig. 14.—Diagrammatic Section of Spinal Cord through the Cervical Enlargement.

Now make a section through the cervical enlargement of the cord whence the big nerves for the brachial plexus come off. Here the transverse diameter is much greater than the antero-posterior, measuring 12 to 14 mm.

The anterior horns are much broader than in the thoracic region, and are prolonged outwards for a considerable distance, the outward prolongation being sometimes known as the *lateral horn* [columna lateralis].

The posterior horns are narrower and do not bulge near the grey commissure, since Clarke's column is practically confined to the thoracic region.

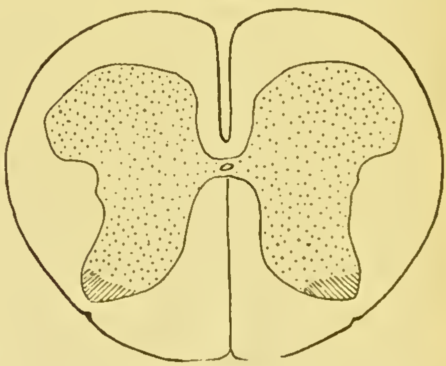


Fig. 15.—Diagrammatic Section of Spinal Cord through the Lumbar Enlargement.

In the white matter the para-median sulcus is best seen in this region, and a delicate septum may sometimes be made out running forwards and inwards from it, cutting off the *column of Goll* [fasciculus gracilis], which lies close to the postero-median fissure, from the *column of Burdach* [fasciculus cuneatus] lying between the septum and the posterior horn (see Fig. 12).

A section should next be made through the lumbar

enlargement of the cord, which differs from the cervical in having its antero-posterior and transverse diameters nearly equal, so that, although the cord is enlarged, the flattened appearance so characteristic of the cervical enlargement is wanting.

A striking feature is the much greater proportion of grey to white matter than in either of the other regions. The anterior horns are actually larger than those of the cervical enlargement, but the thing which enables the experienced eye at once to recognise the lumbar cord is the massive appearance of the posterior horns.

The dissector will, of course, remember that the lumbar enlargement is situated in the lower thoracic region of the spinal canal.

A section through the conus medullaris, whence the lower sacral nerves are rising, shows a still further increase of grey matter at the expense of white, the anterior and posterior horns are practically equal in size, while the grey commissure is very much thicker than in any other region.

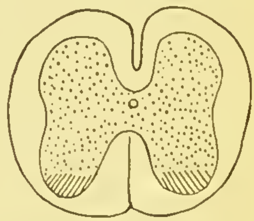


Fig. 16. — Diagrammatic Section through the Spinal Cord at the Level of the Conus Medullaris.

Interior of the Spinal Canal

After the spinal cord has been removed, the empty dural sheath should be reviewed and its limits, particularly its lower one at the level of the second or third sacral vertebra, more carefully determined.

It should then be carefully removed from above downwards, and the anterior part of the *extradural plexus of veins* looked for.

The veins of this plexus are numerous, thin-walled and, especially in the lumbar region, tortuous.

Two *anterior longitudinal spinal veins* should be sought,

one on each side, behind the bodies of the vertebræ. These are connected by cross branches opposite the bodies of the vertebræ, passing between them and the posterior common ligament so that the arrangement is sometimes spoken of as the *spinal venous ladder*.

Each anterior longitudinal vein receives the veins emerging from the cord and sends communicating branches back to the dorsal extradural plexus already noticed (see p. 19). Besides this, at each intervertebral foramen a draining branch runs outwards to the vertebral, intercostal, or lumbar vein as the case may be.

Notice the *Posterior common ligament* [Lig. longitudinale posterius] which runs down behind the bodies of the vertebræ. It begins at the back of the body of the axis, but above that its continuation is known as the posterior occipito-axial ligament. In the cervical region it is ribbon-like, but in the thoracic and lumbar it becomes serrated, widening out opposite the discs where it is attached and narrowing opposite the centra, from which it is separated by the transverse connecting branches of the extradural plexus. These latter of course represent the rungs of the ladder in the simile already suggested.

Cut through the ligament opposite the bodies of one or two lumbar vertebræ, and notice that the transverse veins receive large tributaries, called *venæ basis vertebræ*, coming out of the foramina in the bodies of the vertebræ and being of considerable importance, since the cancellous tissue of the vertebral centra is the chief seat of the blood-forming red marrow. At this stage the body should be turned upon its back.

DISSECTION OF THE POSTERIOR TRIANGLE OF THE NECK

It is important that the posterior triangle should not be left long undissected, because, as soon as the dissectors of the

upper limb have finished their axilla, they will saw through the clavicle and remove the extremity. As this seriously interferes with the relations of the triangle, its dissection should be taken in hand as soon as the body is finally placed on its back.

Place a block beneath the shoulders and hook the face over to the opposite side, thus making the neck tense. If the dissector of the upper extremity is not at work, pull down the shoulder as much as possible; later on it will be realised how great a difference this makes to the contents of the triangle.

Surface Anatomy.—Through the skin the outline of the sterno-mastoid is seen, with the clavicle below and the mastoid process above. The edge of the trapezius is not as evident as that of the sterno-mastoid, but it should be understood that in the undissected state the posterior triangle is a very narrow space, often not more than half an inch across, until the lower part is reached.

The *external jugular vein* is often seen in life through the skin. Its superficial landmark is a line drawn from the angle of the jaw to the middle of the clavicle.

Dissection.—Make a skin incision from the mastoid process to the inner end of the clavicle. Do not cut too deeply, because of the underlying platysma muscle.

From the lower end of this incision make another, through the skin only, along the line of the clavicle if this incision has not been made already by the dissector of the upper extremity. Reflect the flap of skin thus outlined until the anterior edge of the trapezius is exposed (see cuts 4 and 5, Fig. 17).

The *platysma muscle* is now seen as a very delicate sheet running downwards and backwards from the mouth region and passing superficial to the clavicle. Divide this below and reflect it upwards, noticing how very thin it is.

In dissecting it up notice that there is loose cellular tissue deep to it which collapses into a definite sheet as the

platysma is removed. It is this sheet which is known as the *investing layer of the deep cervical fascia.*

Embedded in this cellular tissue is the *external jugular vein,* lying in the line already indicated (p. 33), and probably only coming into the lower part of the dissection. As this vein is traced down it will be seen to reach the posterior

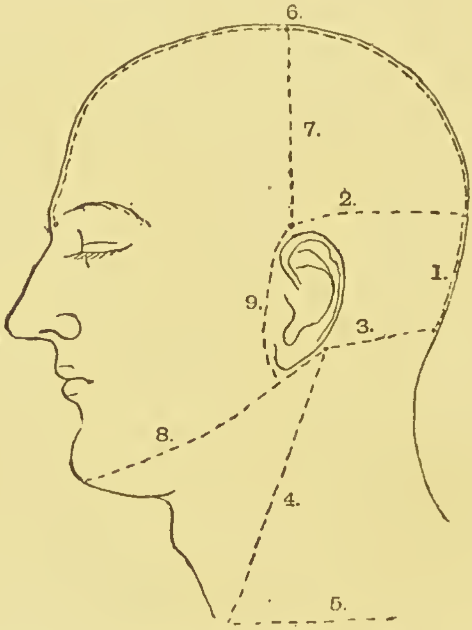


FIG. 17.—SKIN INCISIONS FOR THE DISSECTION OF THE HEAD AND NECK.

border of the sterno-mastoid and then to sink deeper and deeper into the cellular tissue until it is lost to view behind the clavicle. There is no definite place at which it can be said to pierce the deep fascia, since this fascia is really cellular tissue and the vein is always embedded in it.

The act of following the vein will have exposed the posterior border of the sterno-mastoid, and this should now be cleaned very carefully because of the nerves in relation to it.

The *transverse cervical nerve* [N. cutaneus colli] turns

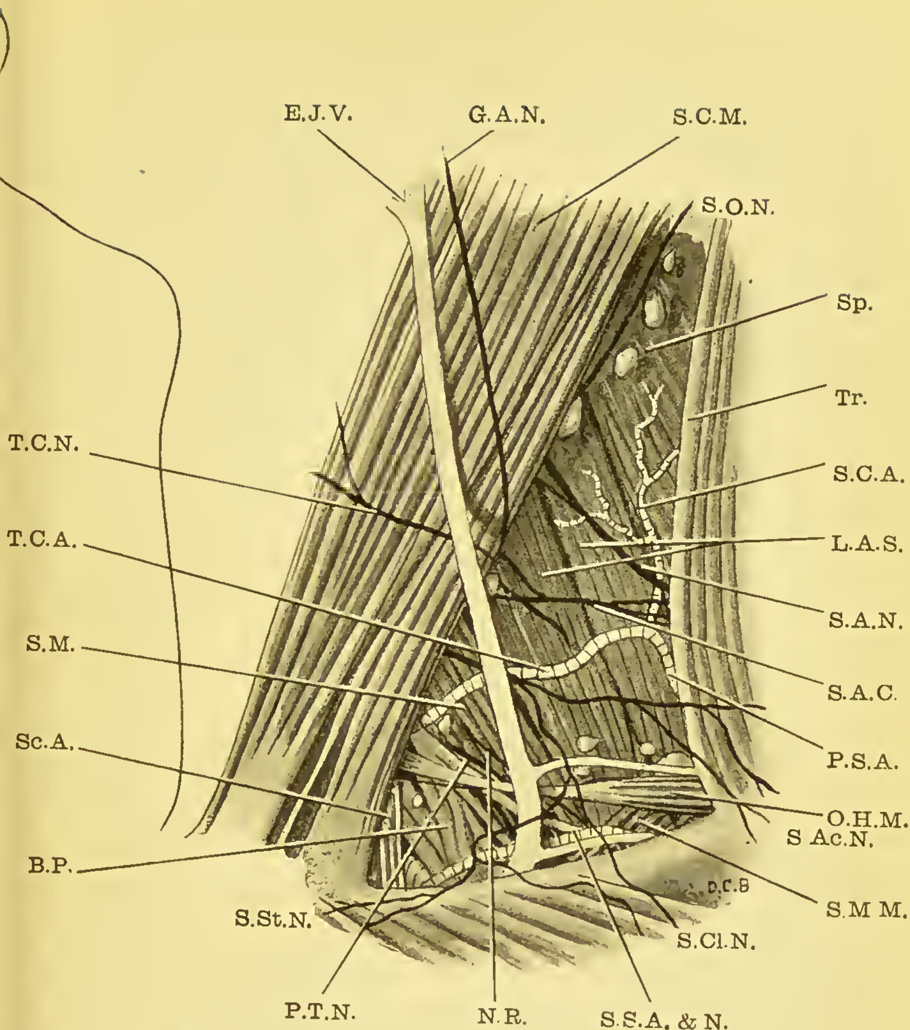


FIG. 18.—DISSECTION OF POSTERIOR TRIANGLE.

E.J.V. External Jugular Vein. *G.A.N.* Great Auricular Nerve. *S.O.N.* Small Occipital Nerve. *Sp.* Splenius Sheet. *Tr.* Trapezius. *S.C.A.* Superficial Cervical Artery. *L.A.S.* Levator Anguli Scapulæ. *S.A.N.* Spinal Accessory Nerve. *S.A.C.* Spinal Accessory Communicating. *P.S.A.* Posterior Scapular Artery. *O.H.M.* Omo-hyoid Muscle. *S.M.M.* Serratus Magnus Muscle. *S.S.A. & N.* Suprascapular Artery and Nerve. *N.R.* Nerve to Rhomboids. *P.T.N.* Posterior Thoracic Nerve. *B.P.* Brachial Plexus. *Sc.A.* Scalenus Anticus. *S.M.* Scalenus Medius. *T.C.A.* Transversalis Colli Artery. *E.J.V.* External Jugular Vein. *S.C.M.* Sterno-cleido Mastoid. *S.Ac.N.* Supra-acromial Nerve. *S.Cl.N.* Supraclavicular Nerve. *S.St.N.* Suprasternal Nerve.

round the middle of this border and runs forward deep to the external jugular vein.

The *great auricular nerve* [N. auricularis magnus] runs upwards and forwards from the same place, and is usually found parallel to and a little above the external jugular vein.

The *small occipital nerve* [N. occipitalis minor] runs upwards and a little backwards also from about the middle of the posterior border of the sterno-mastoid, its course being parallel to this border.

Cutaneous twigs from any or all of these nerves should be looked for, supplying the skin of the posterior triangle.

Lower down, nearer the attachment of the sterno-mastoid, a descending nerve will be found running to the skin superficial to the manubrium sterni; this is the *suprasternal* descending branch of the cervical plexus [N. supraclavicularis anterior].

The *supraclavicular* [N. supraclavicularis medius] descending branch is more external and divides into many twigs which cross the clavicle, while more externally still are the *supra-acromial* branches [N. supraclavicularis posterior] passing to the skin of the shoulder.

Follow up the external jugular vein as far as the limits of the dissection allow, and in cleaning it look for some small lymphatic nodes or glands, as they are often called, lying close to it. These are the *superficial cervical nodes* [Lymphoglandulæ cervicales superficiales].

Now define the anterior edge of the trapezius all the way up, and clean away the fat and cellular tissue near each structure as it is found.

The *spinal accessory* (11*th cranial*) *nerve* [N. accessorius] is the most important structure in the upper part of the triangle, and is sometimes accidentally cut in operations for the removal of deep lymphatic nodes.

The surface marking of the nerve is from midway

between the angle of the jaw and the mastoid process to the middle of the posterior border of the sterno-mastoid. If this line is prolonged until it meets the trapezius, it is not far off the nerve.

The spinal accessory is often mistaken for the supra-acromial in the examination room, but it enters the trapezius on its deep surface, while the supra-acromial passes superficially. *Spinal accessory communicating* branches run outwards and join the eleventh nerve in the posterior triangle and also deep to the trapezius; they come from the third and fourth cervical spinal nerves.

The *deep cervical lymphatic nodes,* which make it so important to know the exact course of the spinal accessory nerve, are normally deep to the sterno-mastoid, though, when they enlarge, they protrude into the posterior triangle. They will be seen better later on.

The *posterior belly of the omo-hyoid muscle* should next be found; it runs across the lower part of the triangle in a direction downwards and outwards, appearing from under cover of the sterno-mastoid about an inch above the clavicle. It divides the posterior triangle into two parts, of which the upper is known as the *occipital* and the lower as the *supra-clavicular triangle.*

Look for the nerve to the posterior belly of the omo-hyoid with great care; it lies just behind the muscle or tendon as it comes from under cover of the sterno-mastoid; its presence in a dissection generally indicates a good dissector.

Now clean the occipital part of the posterior triangle and examine its floor. In doing this several twigs of the *Superficial cervical artery* [A. cervicalis superficialis] will be seen, and to some of them small lymphatic nodes are attached. The muscles forming the floor of this triangle are the Splenius capitis, Levator anguli scapulæ, Scalenus posticus, and Scalenus medius from above downwards, and their fibres all run downwards, outwards, and backwards.

None of their attachments can at present be seen. The boundary between the two first muscles is difficult to determine, but the splenius capitis generally extends for about $1\frac{1}{2}$ inch from the apex of the triangle. In cleaning the levator anguli scapulæ look out for its nerve, which comes from the third and fourth cervical and enters the muscle on its exposed surface. The *Scalenus posticus* is sunk in a small triangle between the levator scapulæ and the scalenus medius. Its attachments have been studied already (p. 12).

In cleaning the *scalenus medius* look out for two nerves piercing it; the larger one is either a part or the whole of the *posterior thoracic* [N. thoracalis posterior] or *nerve of Bell,* while the smaller is the *nerve to the rhomboids* [N. dorsalis scapulæ], which pierces the muscle above and behind the last. This nerve runs down close to the lower border of the levator anguli scapulæ to which it gives off a few branches. On its way it is joined and accompanied by the *posterior scapular artery* [A. circumflexa scapulæ], one of the two branches of the *transversalis colli,* itself a branch of the thyroid axis (see Fig. 18).

The transversalis colli generally divides on the scalenus medius into posterior scapular and superficial cervical branches, though sometimes the former comes off directly from the third part of the subclavian.

Now dissect the small Supraclavicular Triangle, keeping the arm pulled down as much as possible. If the shoulder is pushed up the triangle is non-existent, since its upper boundary, the omo-hyoid, lies behind its lower, the clavicle.

The most important structures in this space are the third part of the subclavian artery and the brachial plexus.

The third part of the subclavian artery [A. subclavia] may be marked out superficially by taking a point from half to one inch above the clavicle along the posterior border of the sterno-mastoid, and drawing a line with a slight con-

vexity outwards from there to the middle of the lower edge of the clavicle. This part of the artery really ends at the outer border of the first rib, so that the whole of it is not seen in this disseetion however much the arm is pulled down.

As this is the first large artery met with in the disseetion of the head and neck, the writer may here point out the advantage of adopting a system in observing and afterwards reealling relations. A list of the more important kinds of structures should be run through for eaeh aspect of the artery and, after the relations have been once earefully observed, the mere mention of the kind of structure will probably suggest the actual relation with very little mental effort.

Under no cireumstanees should a student attempt to learn the relations of arteries by heart from a book; they should be looked at and thought out until they beeome real images in the mind.

Relations are either direct or indirect; the former are aetually in contact, the latter nearly, but not quite, so. Logical aceuracy in these details must not be hoped for, because, strictly speaking, the only direet relation of most arteries is the cellular tissue surrounding them.

Again, relations may change with ehange in the position of a part, so that when the relations of an artery or other structure are asked for in an examination it is usually with the view of giving the candidate a chanee of showing his knowledge of the relative positions of the more important structures.

Applying these remarks to the third part of the sub-elavian artery the following relations will be found:—

In Front.—(The body always supposed to be in the erect position.)

Bones.—Clavicle.

Muscles.—Platysma, Omo-hyoid (sometimes), Subclavius (when the arm is raised).

Fibrous Structures.—Cervical Fascia.

Arteries.—Suprascapular.

Veins.—External Jugular and Suprascapular. (These veins sometimes form quite a plexus in front of the artery and cause a good deal of trouble in tying it.)

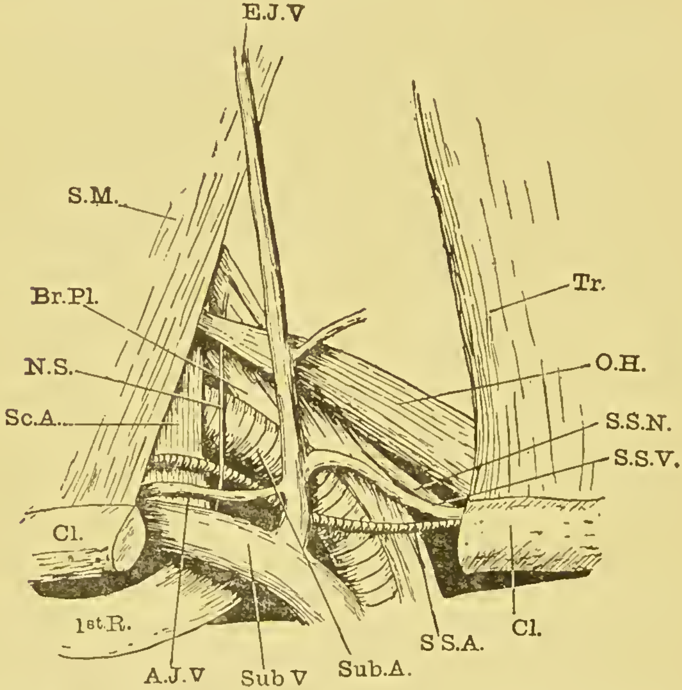


FIG. 19.—RELATIONS OF THE THIRD PART OF THE SUBCLAVIAN ARTERY.

E.J.V. External Jugular Vein. *S.M.* Sterno-mastoid Muscle. *Br.Pl.* Brachial Plexus. *N.S.* Nerve to Subclavius. *Sc.A.* Scalenus Anticus. *Cl.* Clavicle. *1st R.* First Rib. *A.J.V.* Anterior Jugular Vein. *Sub.V.* Subclavian Vein. *Sub.A.* Subclavian Artery. *S.S.A.* Suprascapular Artery. *S.S.V.* Suprascapular Vein. *S.S.N.* Suprascapular Nerve. *O.H.* Omo-hyoid. *Tr.* Trapezius.

Nerves.—Nerve to Subclavius, Supraclavicular Nerves (indirect).

Glandular and other Structures.—Supraclavicular Lymph Nodes.

These structures should be verified with a good deal of

care, since they are met with in the operation for ligature of the third part of the subclavian artery.

In recognising them it will be noticed that the *cervical fascia* is merely condensed cellular tissue, and not a fibrous sheet unless it is artificially made into one by dissection.

The *suprascapular artery* [A. transversa scapulæ] is on its way outwards from the thyroid axis, and lies just behind the clavicle, to which it gives sometimes one, sometimes two, nutrient branches. The artery may be followed outwards and backwards through the cellular tissue deep to the trapezius, accompanying the suprascapular nerve and posterior belly of the omo-hyoid muscle to the notch in the upper border of the scapula.

The *external jugular vein* passes down on its way to the subclavian vein, but the latter is not seen, since it lies altogether below the level of its artery and quite behind the clavicle.

The *transversalis colli* and *suprascapular veins* open into the outer side of the external jugular vein, but their position is not very constant.

The *anterior jugular vein* [V. jugularis anterior] should be sought coming from under cover of the sterno-mastoid and opening into the inner side of the external jugular close to its termination. These veins are of special importance in the living body, because, if cut, there is danger of air being sucked into them—a very dangerous accident.

The *nerve to the subclavius* is very small, and runs down quite close to the outer edge of the sterno-mastoid; it passes behind the clavicle to enter the deep surface of the subclavius.

The *supraclavicular lymph nodes* are fairly large and numerous; they receive vessels coming up from the axilla and shoulder region as well as those from the posterior triangle.

The Posterior Relations of the Third Part of the Subclavian Artery

Bones.—First Rib.

Muscles.—Scalenus Medius and first serration of the Serratus Magnus.

Fibrous Structures.—Cellular tissue.

Arteries and Veins.—None.

Nerves.—The Eighth Cervical and First Thoracic Nerves joining to form the lower trunk of the brachial plexus.

Glandular and other Structures.—None.

It is very important to realise how much the first rib slopes downwards; the slope of its so-called upper surface is the same as that of the so-called anterior surface of the manubrium sterni.

The lower trunk of the plexus lies right down on the rib, and is often mistaken for, and tied instead of, the artery in operations on the dead body. To avoid making this mistake later on, the dissector should find the outer edge of the scalenus anticus, a muscle which is not really in the posterior triangle, since its edge is just behind that of the sterno-mastoid. Follow this edge down with the finger until the first rib is reached, when the artery is the structure immediately behind the finger.

The first serration of the *serratus magnus* is a muscle which is often unexpected in this region. It is easily distinguished by the horizontal direction of its fibres, which form the floor of the supraclavicular triangle. A separate twig of the posterior thoracic nerve is generally seen entering it.

The Superior Relations of the Third Part of the Subclavian Artery are not very numerous; still it is well to go through the usual routine.

Bones.—None.

Muscles.—Omo-hyoid.

Fibrous Structures.—Cellular tissue.

Arteries.—Transversalis Colli (probably indirect).

Veins.—Transversalis Colli.

Nerves.—The greater part of the Brachial Plexus.

Glandular and other Structures.—Some of the Supraclavicular Lymph Nodes.

The only LOWER RELATION of the artery is the First Rib.

The composition of the *Brachial plexus* should be studied with the dissector of the upper extremity, who by this time will have his axilla well exposed. The middle third of the clavicle should be removed, leaving the attachments of the sterno-mastoid and trapezius untouched, but removing with the clavicle a good deal of the subclavius muscle. In doing this the nerve to the subclavius may be traced to its muscle.

It will now be seen that the subclavian vessels and brachial plexus pass from the neck into the axilla through a triangular aperture formed by the first rib internally, the clavicle in front and the scapula behind.

Define the outer edge of the scalenus anticus just behind that of the sterno-mastoid.

Coming out between the scalenus anticus and medius are the *anterior primary divisions of the* 5*th*, 6*th*, 7*th*, *and* 8*th cervical nerves*, while a large contribution from the *first thoracic nerve* ascends in front of the shaft of the first rib close to its neck.

The fifth and sixth nerves join together to form the *upper trunk*, the seventh goes on as the *middle trunk*, while the eighth cervical and first thoracic nerves join to form the *lower trunk* (see Fig. 20).

The formation of these three trunks generally takes place close to the outer edge of the scalenus anticus.

After a short course each trunk divides into *anterior* and *posterior secondary divisions*. It is convenient to speak of these as "secondary" to avoid any mental confusion with the primary division which each nerve undergoes on emerging from the spinal canal.

The anterior secondary divisions of the upper and middle

trunks join to form the *outer cord* of the plexus, that of the lower trunk becomes the *inner cord*, while the posterior secondary divisions of all three trunks unite to form the *posterior cord*. It is usual to speak of upper and lower trunks and inner and outer cords, because the plexus is gradually curving downwards to reach the axilla.

The level of the clavicle corresponds roughly to the

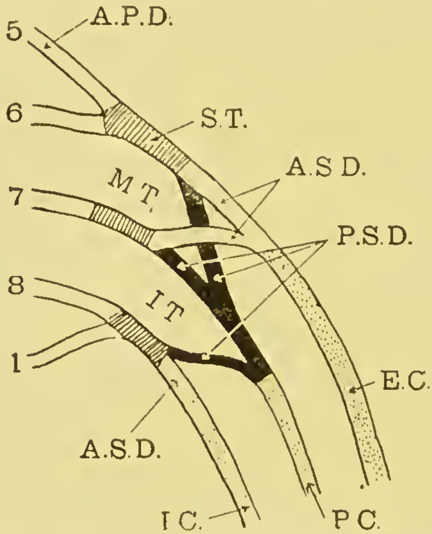


FIG. 20.—DIAGRAM OF BRACHIAL PLEXUS TO SHOW THE DIFFERENT PARTS.

5, 6, 7, 8. The fifth, sixth, seventh, and eighth Cervical Nerves (anterior primary divisions). 1. The part of the Anterior Primary Division of the First Thoracic Nerve entering the Plexus. *S.T.*, *M.T.*, *I.T.* The Superior, Middle, and Inferior Trunks. *A.S.D.* The Anterior Secondary Divisions. *P.S.D.* The Posterior Secondary Divisions. *E.C.* External Cord. *P.C.* Posterior Cord. *I.C.* Internal Cord.

formation of the cords, but the dissector will readily understand that no two plexuses are exactly alike, and that the clavicle may easily be raised or depressed.

All the branches of this plexus, as of the others, are anterior (ventral) or posterior (dorsal), and this is the case even when they come off before the anterior and posterior secondary divisions separate. (In Fig. 21 all the dorsal branches are black.)

The only branches which concern the dissector of the posterior triangle are: (1) the nerve to the rhomboids; (2) the nerve to the subclavius; (3) the posterior thoracic nerve; (4) the suprascapular nerve.

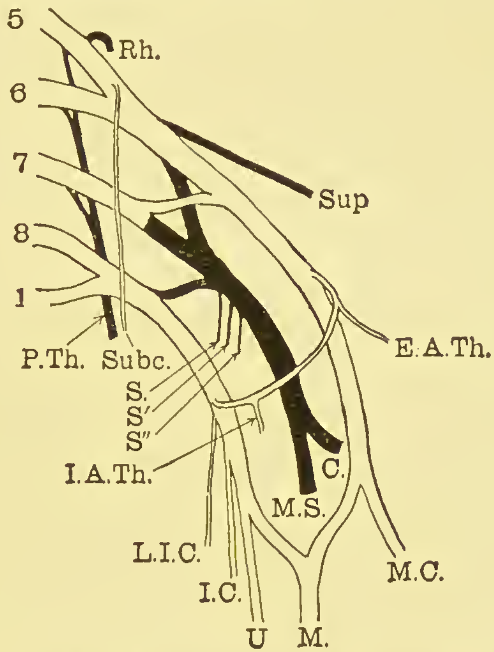


FIG. 21.—THE COMPOSITION OF THE BRACHIAL PLEXUS.

(The ventral nerves are white, the dorsal black.)

5, 6, 7, 8, 1. The Cervical and Thoracic Nerves. *Rh.* Nerve to Rhomboids. *P.Th.* Posterior Thoracic. *Subc.* Nerve to Subclavius. *Sup.* Suprascapular Nerve. *S.*, *S′.*, *S″.* The Upper, Middle, and Lower Subscapular Nerves. *E.A.Th.* External Anterior Thoracic Nerve. *I.A.Th.* Internal Anterior Thoracic Nerve. *M.C.* Musculo-cutaneous Nerve. *M.* Median Nerve. *U.* Ulnar Nerve. *I.C.* Internal Cutaneous Nerve. *L.I.C.* Lesser Internal Cutaneous Nerve. *C.* Circumflex Nerve. *M.S.* Musculo-spiral Nerve.

Of these the *nerve to the subclavius* alone is anterior or ventral. Both it and the *suprascapular nerve* may be seen coming off the junction of the fifth and sixth cervical nerves to form the upper trunk, while the origins of the other two cannot at present be seen since they pierce the scalenus medius.

The suprascapular nerve then runs outwards and downwards above the level of the rest of the plexus (see Fig. 19). It may be worth while to insist once more on the fact that the suprascapular *nerve*, the suprascapular *artery*, and the omo-hyoid *muscle* converge on the suprascapular notch; while the *nerve* to the rhomboids, the posterior scapular *artery*, and the levator anguli scapulæ *muscle* converge on the upper angle of the scapula.

When the posterior scapular artery rises from the third part of the subclavian, it usually passes between the trunks or cords of the plexus.

THE SCALP

Now that the body is on its back the student will see how difficult it is to reach the occipital region satisfactorily, and he will appreciate the advantage of having dissected this part already.

Before beginning the actual dissection the following landmarks should be carefully identified:—

A. Median Landmarks

1. *Nasion.*—The mid point of the naso-frontal suture at the root of the nose.

2. *Bregma.*—Easily localised by passing a piece of string vertically across the head from a point just in front of one ear to the other; a slight depression is sometimes felt at this site.

3. *External Occipital Protuberance* [protuberantia occipitalis externa].—At the junction of the scalp and neck; often difficult to feel in females.

4. *Lambda.*—The point at which the parietal and occipital bones meet in the mid line about a hand's-breadth (2¾ to 3 inches) above the external occipital protuberance. Here, too, a slight depression may sometimes be felt.

B. LATERAL LANDMARKS (symmetrical)

1. *Supraorbital margin* [margo - supraorbitalis].—Just below the eyebrow, with the *supraorbital notch* [incisura supraorbitalis] at the junction of the inner and middle thirds. Sometimes a foramen replaces the notch, which then cannot be felt.

2. *External Angular Process*.—Where the supraorbital margin joins the malar bone. The suture here may usually be felt through the skin.

3. *Supraciliary Eminence* [arcus superciliaris].—A little above the eyebrow, better marked in the male, and situated in front of the frontal air sinus, which lies between the two tables of the frontal bone.

4. *Frontal Eminence* [tuber frontale].—About an inch above the supraciliary, usually more prominent in the female, and forming the greatest convexity of the forehead on each side.

5. *Temporal Crest* [linea temporalis].—Running upwards and then backwards from the external angular process. This can be traced for some little distance in the male, but less distinctly in the female.

6. *Upper Border of Zygoma*.—Continued forwards and upwards into the posterior margin of the malar bone, and so to the external angular process.

7. *Parietal Eminence* [tuber parietale].—The point of greatest convexity of each parietal bone.

8. *Mastoid Process* [P. mastoideus].—Behind the ear and larger in the male. The tip seldom reaches quite as low as the lowest point of the lobe of the ear.

9. *Supramastoid Crest*.—Continuing the upper border of the zygoma back above the attachment of the pinna, and gradually turning upwards on to the parietal bone.

A skull should be at hand for comparison in case of difficulty in identifying any of these points.

Now make a median incision through the skin from the

root of the nose to the place in the occipital region whence the skin has been reflected already. From the middle of this another should be made at right angles to end in front of the ear (see Fig. 17).

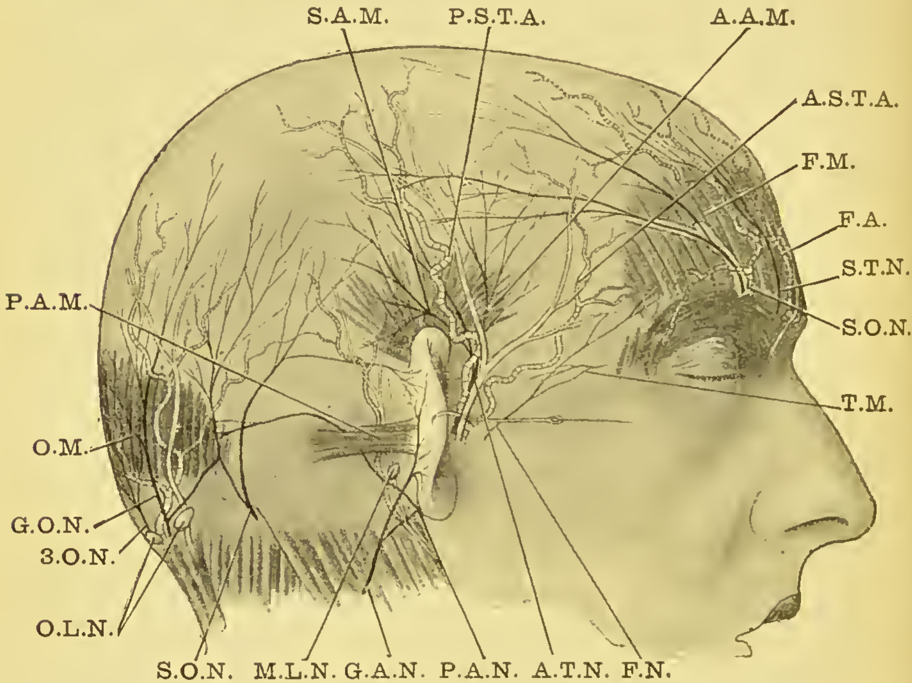


Fig. 22.—Dissection of the Scalp.

S.O.N. Small Occipital Nerve. *O.L.N.* Occipital Lymphatic Nodes. 3.*O.N.* Third Occipital Nerve. *G.O.N.* Great Occipital Nerve. *O.M.* Occipitalis Muscle. *P.A.M.* Posterior Auricular Muscle. *S.A.M.* Superior Auricular Muscle. *A.A.M.* Anterior Auricular Muscle. *P.S.T.A.* Posterior Branch of Superficial Temporal Artery. *A.S.T.A.* Anterior Branch of Superficial Temporal Artery. *F.M.* Frontalis Muscle. *F.A.* Frontal Artery. *S.T.N.* Supratrochlear Nerve. *S.O.N.* Supraorbital Nerve and Artery. *T.M.* Temporal Branch of Temporomalar Nerve. *F.N.* Temporal Branch of Facial Nerve. *A.T.N.* Auriculo-temporal Nerve. *P.A.N.* Posterior Auricular Nerve. *G.A.N.* Great Auricular Nerve. *M.L.N.* Mastoid Lymphatic Node.

Reflect the two triangular flaps downwards, being very careful to keep close to the skin and not to go through the aponeurosis of the occipito-frontalis muscle. All the fat and blood vessels are superficial to this, and as long as these and

the roots of the hairs can be seen, the aponeurosis is safe. Reflecting the skin of the scalp is tedious work, because the connective tissue is so dense and binds the skin down to the subjacent aponeurosis, thus separating the fat into little pellets.

As soon as the skin is reflected, look out for the cutaneous nerves.

The *Supraorbital Nerve* [N. supraorbitalis] should be found as it comes out of its notch in the supraorbital margin. To reach it here the fibres of the orbicularis palpebrarum muscle surrounding the orbit must be cut through. The nerve divides into an external and an internal branch, sometimes before, sometimes after, leaving the notch, and both of these must be looked for. They both pierce either the frontalis muscle or its aponeurosis, usually the former, though the internal branch does so first. With care the external branch may be dissected back beyond a vertical line drawn upwards from the external auditory meatus, the internal not quite so far.

The *Supratrochlear Nerve* [N. supratrochlearis] should next be found, as it rounds the supraorbital margin a quarter of an inch internal to the supraorbital nerve. It soon pierces the anterior belly of the occipito-frontalis muscle, and may be followed up on to the forehead for two inches or so.

Both the foregoing are branches of the first division of the trigeminal or fifth cranial nerve.

The *temporal branch of the temporo-malar nerve* [N. zygomatico-temporalis] is found piercing the temporal fascia, about an inch behind the external angular process. The easiest way to find this small and somewhat elusive nerve is to pass the finger-nail along the posterior border of the malar bone until the tubercle is felt; the nerve lies just above this. It is the only branch of the second division of the fifth nerve on the scalp, and supplies the skin superficial to the front of the temporal region.

The anterior belly of the occipito-frontalis muscle, which has been seen in displaying the foregoing nerves, is supplied by the *temporal branch of the facial or seventh cranial nerve* [Ramus temporalis nervi facialis]. This should now be looked for running obliquely upwards and forwards, crossing the zygoma near its posterior end. By carefully dissecting along the posterior half of the zygoma the nerve will certainly be found, and a small twig of it should be looked for supplying the anterior and superior auricular muscles.

It is very important to realise, once for all, that the branches of the facial nerve are entirely motor, and not to confuse them with sensory nerves.

The *auriculo-temporal nerve* [N. auriculo-temporalis] represents the third division of the fifth on the scalp. It should be sought where it crosses the backward prolongation of the zygoma, just in front of the ear and usually behind or deep to the superficial temporal artery. Its fibres may be traced to the skin of the side of the head as far back as the line of the ear as well as to the upper half of the outer surface of the pinna. (Only follow the nerves on to the pinna on one side.)

Close behind the ear a sensory and a motor nerve must be found; the former is the *great auricular nerve* [N. auricularis magnus] from the cervical plexus. Twigs of this supply the skin over the mastoid process, the greater part of that surface of the pinna which lies against the head and the lower part of the outer surface of the pinna. The trunk of this nerve has been found already in the dissection of the posterior triangle (see p. 36).

The motor nerve behind the ear is the *posterior auricular branch of the facial* [N. auricularis posterior], supplying the posterior auricular muscle, the posterior intrinsic muscles of the ear and the posterior belly of the occipito-frontalis. To find it hook the ear forwards and clean the *posterior auricular muscle*, which runs from the base of the

mastoid process to it. The nerve lies deep to the muscle and then runs upwards and backwards to the occipitalis muscle, as the posterior belly of the occipito-frontalis is often called.

The last nerve of the scalp is the *great occipital,* the

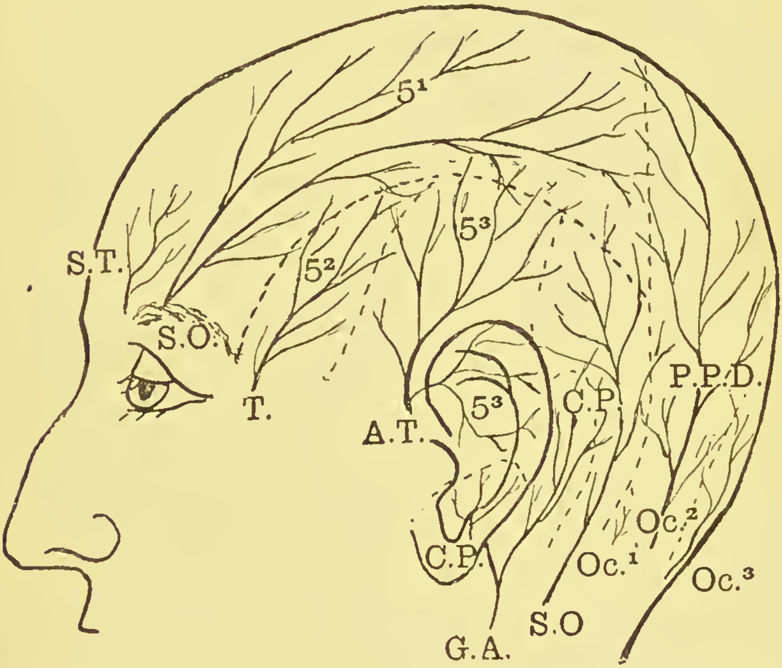


FIG. 23.—DIAGRAM OF THE CUTANEOUS NERVES OF THE SCALP.

5^1. Ophthalmic Division of the Fifth Cranial Nerve. 5^2. Maxillary Division of the Fifth Cranial Nerve. 5^3. Mandibular Division of the Fifth Cranial Nerve. *C.P.* Cervical Plexus. *P.P D.* Posterior Primary Divisions. *S.T.* Supratrochlear. *S.O.* Supraorbital. *T.* Temporo-malar. *A.T.* Auriculo-temporal. *G.A.* Great Auricular. *S.O.* Small Occipital. Oc^1. Suboccipital. Oc^2. Great Occipital. Oc^3. Accessory Occipital.

cutaneous part of the posterior primary division of the second cervical nerve; its trunk has been found already (see p. 2).

The suboccipital and third occipital nerves were looked for while the body was on its face.

In reviewing these cutaneous scalp nerves it will be noticed how regular is their succession from before back.

There are first, second, and third divisions of the fifth, then anterior primary divisions of the cervical nerves; and finally first, second, and third posterior primary branches of the cervical nerves (see Fig. 23).

The *arteries of the scalp* have three characteristics: (1) they are very tortuous; (2) they anastomose freely across the mid line; (3) they are closely attached to the dense fibres of the subcutaneous connective tissue in which they lie. For this reason, when wounded during life, they cannot contract properly, and so bleed very freely.

Starting from the mid line anteriorly, the *frontal artery* [A. frontalis] is found close to the supratrochlear nerve; then comes the *supraorbital artery* [A. supraorbitalis] accompanying its nerve, while, at the outer margin of the orbit, a few twigs from the *lacrimal artery* [A. lacrimalis] may be found.

All these are branches of the ophthalmic artery and so of the internal carotid system.

The *superficial temporal artery* [A. temporalis superficialis] is one of the terminal branches of the external carotid, and its trunk is seen just in front of the pinna. It divides into anterior and posterior branches, of which the former [ramus frontalis] runs forwards and upwards, and is the tortuous artery so often seen through the skin in the temples of old people.

The posterior branch [ramus parietalis] runs nearly vertically upwards.

The *Posterior Auricular Artery* [A. auricularis posterior] is another branch of the external carotid; it divides into auricular and mastoid branches.

The *Occipital Artery* [A. occipitalis] reaches the scalp close to the great occipital nerve, and divides into branches for the occipital region. Its size varies inversely with that of the posterior auricular artery.

The *veins of the scalp* will be seen while the arteries are being dissected. They do not form a pair of venæ comites accompanying each artery, as would be the case with arteries

of the same size elsewhere in the body. Although they have the same names as the arteries, they are not tortuous, and so are often some distance away. They anastomose very freely, and for practical purposes make a wide meshed

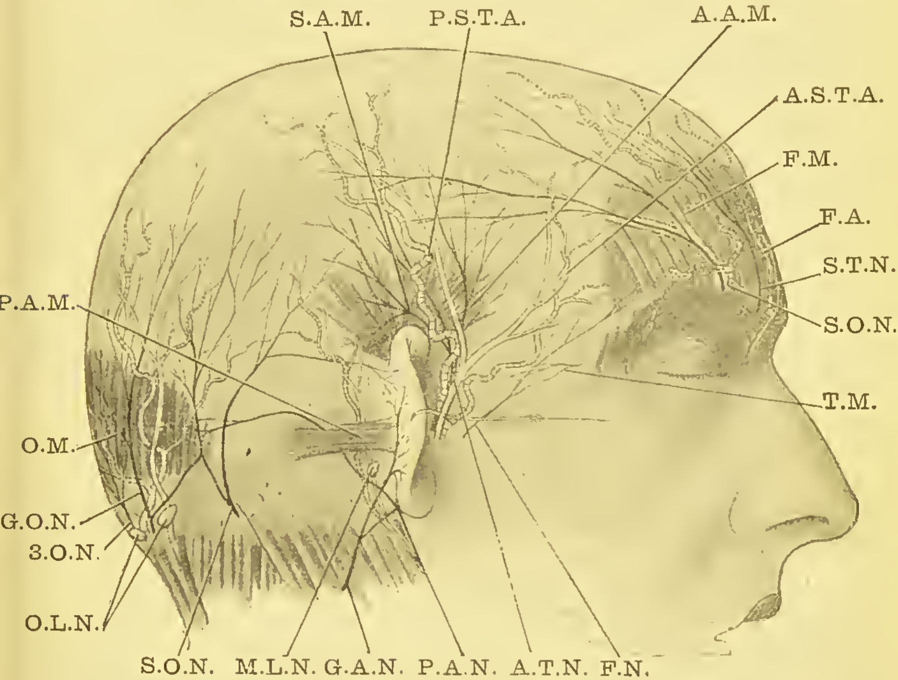


FIG. 24.—DISSECTION OF THE SCALP.

S.O.N. Small Occipital Nerve. *O.L.N.* Occipital Lymphatic Nodes. *3.O.N.* Third Occipital Nerve. *G.O.N.* Great Occipital Nerve. *O.M.* Occipitalis Muscle. *P.A.M.* Posterior Auricular Muscle. *S.A.M.* Superior Auricular Muscle. *A.A.M.* Anterior Auricular Muscle. *P.S.T.A.* Posterior Branch of Superficial Temporal Artery. *A.S.T.A.* Anterior Branch of Superficial Temporal Artery. *F.M.* Frontalis Muscle. *F.A.* Frontal Artery. *S.T.N.* Supratrochlear Nerve. *S.O.N.* Supraorbital Nerve and Artery. *T.M.* Temporal Branch of Temporomalar Nerve. *F.N.* Temporal Branch of Facial Nervo. *A.T.N.* Auriculo-temporal Nerve. *P.A.N.* Posterior Auricular Nerve. *G.A.N.* Great Auricular Nerve. *M.L.N.* Mastoid Lymphatic Node.

plexus all over the scalp. Where they are close to their arteries they lie superficial to them.

The *lymphatic vessels of the scalp* are not usually seen, but their course corresponds to that of the veins.

Superficial to the mastoid process are one or two small *mastoid nodes* [Lymphoglandulæ auriculares posteriores] draining the posterior auricular region, while the posterior part of the scalp drains into the *occipital nodes* already seen (see p. 2).

The vessels and nerves having been traced and sketched, the *muscles of the scalp* should be studied.

The *anterior belly of the occipito-frontalis* (*frontalis*) *muscle* has been cut already in its lower part. Now cut it right across on one side of the forehead and turn it forward; this will show that it has no bony attachments, but merely blends with the orbicularis palpebrarum above the orbit. Near the mid line, however, it is prolonged down the root of the nose as the *pyramidalis nasi.* The posterior belly or *occipitalis* has been dissected already (see p. 3).

There is a considerable interval between the occipitales muscles of opposite sides, and here the aponeurosis reaches back to the curved line while the two frontales converge and touch one another near the root of the nose.

The frontales muscles cause the horizontal wrinkles of the forehead. Watch these appearing in a living person, and note that the skin of the forehead is pulled up, not down, in their formation; this shows that the muscles act from the aponeurosis. Note too that the wrinkles are not really horizontal, but that there is a downward convexity in the mid line, because the frontales do not meet in the mid line until the root of the nose is reached. Divide the aponeurosis (*epicranium*), joining the occipitalis to the frontalis by a transverse cut, and turn part of it back. This will show how thin the membrane is and how loosely it is bound down to the subjacent periosteum by strands of areolar tissue running across the *subaponeurotic lymph space.* It will now be easily understood that any subaponeurotic collection of fluid (blood or pus) will not be localised, but will soon make its way to the most dependent points.

This is sometimes known as the "dangerous area of the scalp," because matter can so readily make its way in all directions between the aponeurosis and the pericranium. It is the existence of this space which allows the scalp to be so easily torn off in machinery accidents.

Laterally the epicranium becomes still thinner, but gives origin to the *anterior* and *superior auricular muscles,* while the posterior rises from the bony mastoid process.

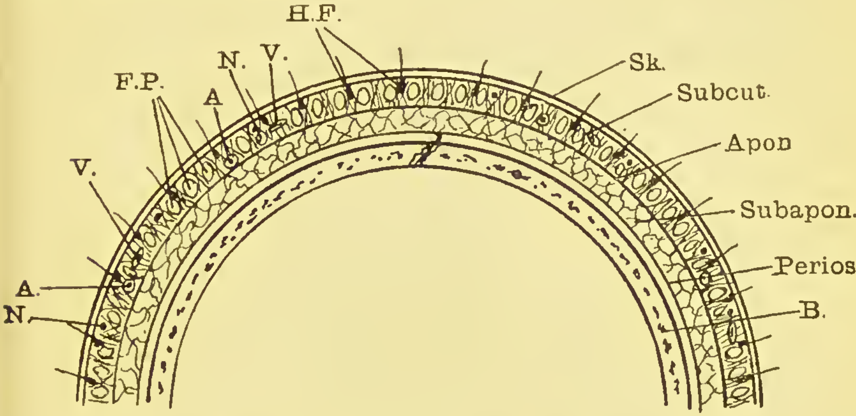


FIG. 25.—DIAGRAMMATIC SECTION OF SCALP.

Sk. Skin. *Subcut.* Subcutaneous Tissue. *Apon.* Aponeurosis of Occipito-frontalis. *Subapon.* Subaponeurotic (dangerous) area. *Periost.* Periosteum. *B.* Bone. *H.F.* Hair Follicles. *A.*, *N.*, *V.* Scalp Arteries, Nerves, and Veins. *F.P.* Isolated Pellets of Fat.

The deepest layer of the scalp is the periosteum of the skull vault (*pericranium*). Cut this through across one of the sutures, and, in lifting it up, notice how closely it is attached to the bone at the suture. Until the sutures are closed, a process which is usually complete internally about the fortieth year, it is continuous with the dura mater inside the skull; consequently any subpericranial effusion will be limited to the outline of one of the cranial bones.

Reviewing the structure of the scalp it is evident that five layers must be recognised: (1) skin; (2) subcutaneous layer containing fat, hair follicles, vessels, and nerves, and

closely binding the skin to (3) the epicranium or occipito-frontalis muscle and aponeurosis; (4) loose subaponeurotic lymph space; (5) pericranium or periosteum.

THE PINNA

Although the pinna or auricle [Auricula] is a part of the auditory apparatus, the examination of the rest of which

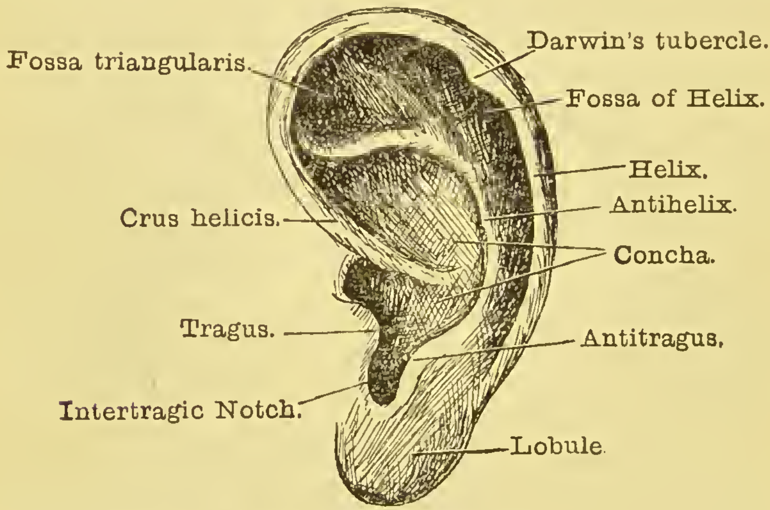


FIG. 26.—EXTERNAL SURFACE OF THE PINNA.

must be postponed for a long time, it is better to dissect it with the scalp, because it dries up very quickly, and also because it is sometimes convenient to cut it away in deeper dissections.

The surface markings of the pinna may be studied on a living person's head as well as they can be on the dead subject; indeed, it is very advisable to get into the way of noticing the endless variations of the different parts of the pinna in different individuals, because they are of great importance for identification in medico-legal cases.

Looking first at the outer surface, a marginal rim called the *helix* will be easily identified; it begins just above the

external auditory meatus as an oblique ridge called the *crus helicis.* Where it has finished its upper arch and is beginning to run down the hinder border of the pinna, it often shows a little triangular widening known as *Darwin's tubercle.*

Below, the helix ends in the soft *lobule of the ear,* which varies so greatly in size in different people, and is the part pierced for earrings.

Running up from the lobule, parallel with the helix, is another ridge, the *Antihelix* [Anthelix], while between the two is the *fossa of the helix.*

In the upper part of the pinna the antihelix divides to enclose a triangular fossa sometimes called the *fossa of the Antihelix,* sometimes the *fossa triangularis.*

The deep hollow bounded above and behind by the antihelix, from the bottom of which the external auditory meatus leads, is the *concha* [cavum conchæ], and is divided into an upper and lower part by the crus helicis.

In front of the external auditory meatus and overlapping it is a triangular flap called the *tragus,* while a little below and behind is another slighter flap projecting forwards from where the antihelix joins the lobule. This is the *antitragus,* and it is separated from the tragus by a well-marked *intertragic notch* [incisura intertragica].

When the cranial or inner surface of the pinna is looked at, eminences will be seen corresponding to the three fossæ; one for the concha, one for the fossa of the helix, and a third for that of the antihelix.

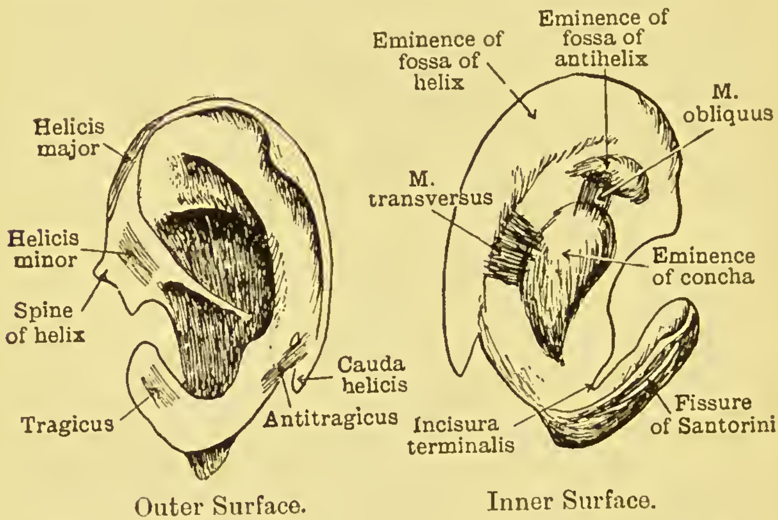
The two dissectors should next remove the skin and notice the positions of the muscles on one pinna, the other having been used for the cutaneous nerves.

Six small intrinsic muscles will be seen which, although of morphological interest, are of no practical importance. Their names and position are shown in the accompanying diagrams (Figs. 27 and 28), and twigs of the facial nerve may with the greatest care be traced to them.

The stiffness of the pinna is now seen to be due to a framework of fibro-cartilage which is continuous with that in the walls of the external auditory meatus, and reproduces, with a few points of difference, the contour of the surface of the pinna.

The chief point of difference is that the lobule consists of fibro-fatty material and contains no cartilage.

Another is that the cartilage of the helix ends below in



FIGS. 27 AND 28.—CARTILAGE AND MUSCLES OF THE PINNA.

a tail-like process known as the *cauda helicis*, which can be easily felt in the ear of a living person.

At the anterior part of the cartilage of the helix, just below the point at which the ear joins the head, is the *spina helicis*, to which a strong ligament, binding it to the head, is attached.

That part of the cartilage which supports the tragus and is continued into the auditory meatus is nearly separated from the rest by a very deep *terminal notch* [incisura terminalis], while in the anterior part of this cartilage, which is sharply bent in towards the meatus, there is the *fissure of Santorini*.

INTRACRANIAL REGION

When the soft parts have been cleared off the vault of the skull the sutures are seen, and even in the skulls of quite old people are sometimes patent superficially. The sagittal suture closes earliest and most completely between the parietal foramina, while the coronal does so below the point where the temporal ridge crosses it. Closure at these points occurs between the thirtieth and fortieth years.

Screw the coronet on to the skull a little above the supraciliary eminences in front, and about an inch above the external occipital protuberance behind. Saw through the external table all round, keeping the saw close to the coronet. As soon as any sign of blood is seen on the saw it shows that the diploe has been reached, and the cut should go no deeper there, though in bodies injected with formalin this sign is often wanting. The best kind of chisel to use for the rest of the work is one which is bent at a right angle near the cutting edge; this can be used as a lever and hook for dragging the vault off when it is nearly divided, but if one of these is not provided, an ordinary chisel and mallet should be carefully used.

The Dura Mater lies quite close to the inner surface of the cranium, but if enough care is taken it should not be damaged, and its outer aspect may be studied as soon as the skull-cap is removed.

This outermost and thickest membrane of the brain acts also as the internal periosteum of the skull bones, and between the membrane and the skull the meningeal arteries lie. They are accompanied by veins which, much more than the arteries, are responsible for the grooves in the skull bones.

The anterior branch of the *middle meningeal artery* [A. meningea media] will be found coming up from the pterion and usually lying in a canal in the parietal bone a little below the point of section, while the posterior branch is some inches further back.

These two branches supply all the bony vault of the cranium as well as the dura mater.

The *Superior Longitudinal Sinus* [S. sagittalis superior] may be seen easily in the mid line, and should be cut into posteriorly and then laid open on a probe or director. When its cavity has been sponged clean, it will be seen that it is triangular in section and is formed by a splitting of the

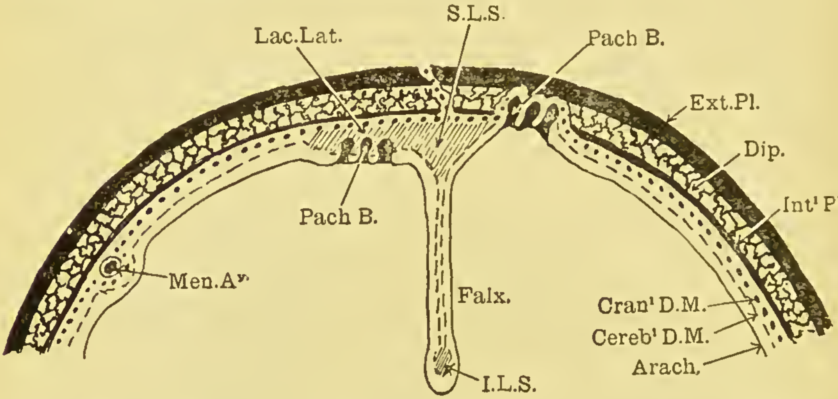


FIG. 29.—DIAGRAMMATIC CORONAL SECTION OF THE CRANIAL VAULT.

Cran'.D.M. Cranial Dura Mater (dotted line). *Cereb'.D.M.* Cerebral Dura Mater (interrupted line). *Int'.Pl.* Internal Plate of Parietal Bone. *Dip.* Diploe Plate of Parietal Bone. *Ext.Pl.* External Plate of Parietal Bone. *Pach.B.* Pacchionian Bodies. *S.L.S.* Superior Longitudinal Sinus. *Lac.Lat.* Lacuna Lateralis. *Men.Av.* Meningeal Artery. *I.L.S.* Inferior Longitudinal Sinus. *Arach.* Arachnoid.

dura mater, which everywhere consists of a *cranial* or superficial layer, acting as the internal periosteum of the skull bones, and a *cerebral* or deep layer nearer the brain. Where the venous sinuses are, these two layers are separate and enclose the blood, but elsewhere they are so closely joined as to be indistinguishable from one another.

As the sinus is traced forwards. it becomes smaller, while behind it gradually enlarges until the *Torcular Herophili* [confluens sinuum] or meeting-place of the sinuses is reached.

In the side-wall of the slit sinus orifices, often valvular

in appearance, may be seen, which lead from the *lacunæ laterales*, creek-like openings into the main stream, which bear very much the same relation to the superior longitudinal sinus that the Norfolk Broads do to their rivers. Lay open some of these lacunæ and look for *Pacchionian bodies* [Granulationes arachnoideales] projecting into their cavity; these are masses of hypertrophied villous outgrowths of the arachnoid membrane which push their way through the dura mater into the lacuna. With care they may be withdrawn, and then the floor of the lacuna has a delicate pattern of minute perforations. When they grow large enough they make depressions in the inner table of the frontal and parietal bones. They are usually found near the superior longitudinal sinus, and are better marked in old than in young people.

Now make two incisions parallel with the superior longitudinal sinus, one on either side of it.

From the centre of each of these make another cut outwards at right angles, and carry it as far as possible; then turn the four flaps aside.

This opens up the *subdural space* [cavum subdurale] between the smooth inner surface of the dura mater and the outer surface of the arachnoid, a membrane which is so transparent that the convolutions of the brain, as well as the cerebral arteries and veins, are seen easily through it. The last of these turn forwards before entering the lacunæ laterales or superior longitudinal sinus.

The further steps depend on the condition of the brain; if it is obviously useless, it is better to clear it away piecemeal, leaving the dura mater with its various folds in position. In this event a fresh brain may usually be obtained elsewhere.

In most bodies injected with formalin, however, the brain is already moderately hard, and may be removed without difficulty.

It should be understood that in life the subdural space

is a mere cleft, the dura mater and arachnoid being in contact.

Separate the two lobes of the cerebrum gently and look for the *falx cerebri*, a median septum of the dura mater lying between them. This, as its name implies, is sickle-shaped, and becomes gradually deeper as it runs back.

Divide it with scissors as close as possible to the crista galli, and reflect it.

Now let the head hang well back, and gently lift the frontal lobes from the anterior fossa of the skull until the olfactory bulbs are seen lying on the cribriform plate of the ethmoid. In the post-mortem room the object is to remove every part of the brain, but in the dissecting room, since it is almost always possible to get another brain, it is better to divide the olfactory tract on one side, thus leaving one lobe in position.

Continue drawing back the frontal lobes until the optic nerves and commissure come into view.

Just to the outer side of these will be seen the large *internal carotid arteries*, which should be divided close to the brain. The optic nerves, too, should be divided close to the commissure.

Still drawing the front of the brain gently back, the *infundibulum*, or stalk of the pituitary body, comes into view and must be cut through.

Now turn the head as much as possible to one side, and raise the temporal lobe of the other side from the middle fossa of the skull.

When the upper border of the petrous bone is reached, a membrane will be seen running back from it, separating the cerebral hemisphere from the cerebellum: this is the *tentorium cerebelli*. As the mid line is approached it will be seen that the tentorium has a free edge bounding an opening, sometimes known as the *foramen ovale of the tentorium*, through which the crura cerebri pass up to the cerebral hemispheres.

These crura should be divided as close as possible to the hemispheres, taking great care to leave the third nerves, which run forwards from their inner sides, in the skull.

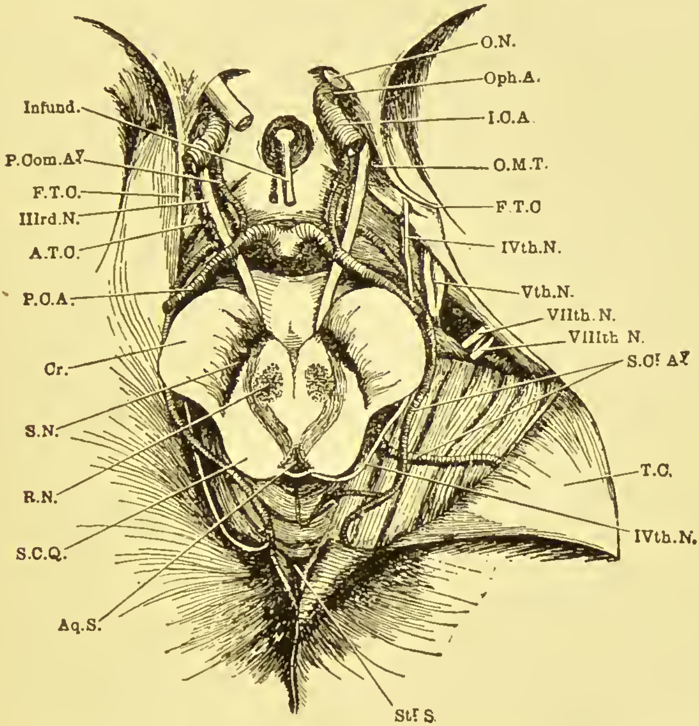


FIG. 30.—ATTACHMENT OF THE TENTORIUM CEREBELLI AFTER REMOVAL OF THE CEREBRUM.

Infund. Infundibulum. *P.Com.A^{y}.* Posterior Communicating Artery. *III, IV, V, VII, VIII, N.* The Respective Cranial Nerves. *F.T.C.* Free Part of Tentorium. *A.T.C.* Attached Part of Tentorium. *P.C.A.* Posterior Cerebral Artery. *Cr.* Crusta. *S.N.* Substantia Nigra. *R.N.* Red Nucleus. *S.C.Q.* Superior Corpus Quadrigeminum. *Aq.S.* Aqueductus Sylvii. *St^{r}.S.* Straight Sinus. *T.C.* Tentorium reflected. *S.C^{r}.A^{y}.* Superior Cerebellar Artery. *O.M.T.* Oculomotor Triangle. *I.C.A.* Internal Carotid Artery *Oph.A.* Ophthalmic Artery. *O.N.* Optic Nerve.

In dividing the crura the posterior cerebral arteries, which lie just in front of them and above the third nerves, must also be cut.

The cerebral hemispheres may now be lifted out of the skull, noticing that the only nervous structures which have been divided are the optic nerves, one olfactory tract, the infundibulum, and the crura cerebri.

Notice that here and there small veins which pass from

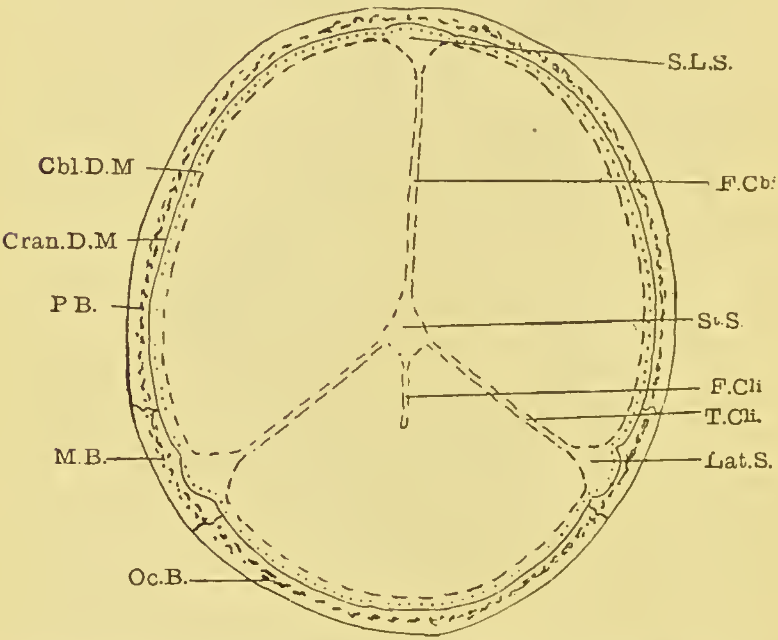


FIG. 31.—CORONAL SECTION THROUGH THE BACK OF A SKULL TO SHOW THE PROCESSES OF THE DURA MATER IN RELATION TO THE SINUSES.

Cbl.D.M. Cerebral Dura Mater. *Cran.D.M.* Cranial Dura Mater. *P.B.* Parietal Bone. *M.B.* Mastoid Bone. *Oc.B.* Occipital Bone. *S.L.S.* Superior Longitudinal Sinus. *F.Cbi.* Falx Cerebri. *St.S.* Straight Sinus. *F.Cli.* Falx Cerebelli. *T.Cli.* Tentorium Cerebelli. *Lat.S.* Lateral Sinus.

the surface of the brain to the dura mater, to open into the sinuses, have been torn in removing the brain. These are sometimes known as "*anchor veins*," and are of importance in operations upon the brain.

Put plenty of tow or cotton-wool into a pot, place the brain upside down upon it and cover it with strong spirit.

Its injected vessels will be valuable for comparison with those of the second brain.

Examine the falx cerebri, and notice that it has blood sinuses between its layers, *superior longitudinal sinus* above and the very small *inferior longitudinal* below. Posteriorly, where it is so much deeper, it joins the tentorium cerebelli in the mid line, and forms the ridge pole of the tent after which this structure is named. At the anterior point of the junction between the falx and tentorium the inferior longitudinal sinus receives a vein which comes out of the back of the brain, known as the *great vein of Galen* [V. cerebri magna]. These two veins, having joined, run backwards and downwards as the *straight sinus* [S. rectus], the walls of which are formed by a splitting of the layers of the dura mater along the line of attachment of the falx cerebri with the tentorium cerebelli. This straight sinus, as well as the inferior longitudinal, should be slit open as far as possible.

The *tentorium cerebelli*, seen from above, is really very tent or awning like; it is fixed posteriorly to the skull opposite the internal occipital protuberance, and its attached border can be traced outwards as far as the outer end of the upper border of the petrous bone, then inwards and forwards along this border until the posterior clinoid process is reached. From the internal occipital protuberance to the petrous bone, its attached border splits to enclose the horizontal part of the *lateral sinus* [S. transversus], while where it is fastened to the petrous bone it encloses a much smaller sinus, the *superior petrosal* [S. petrosus superior] (see Fig. 32).

Slit open these sinuses, and examine them; it will be seen that the superior longitudinal sinus generally (three times out of four) passes almost directly into the right lateral, while the straight sinus turns into the left. There is, however, a communication between the two sides, and this meeting-place of the sinuses is known as the *torcular Herophili* [confluens sinuum].

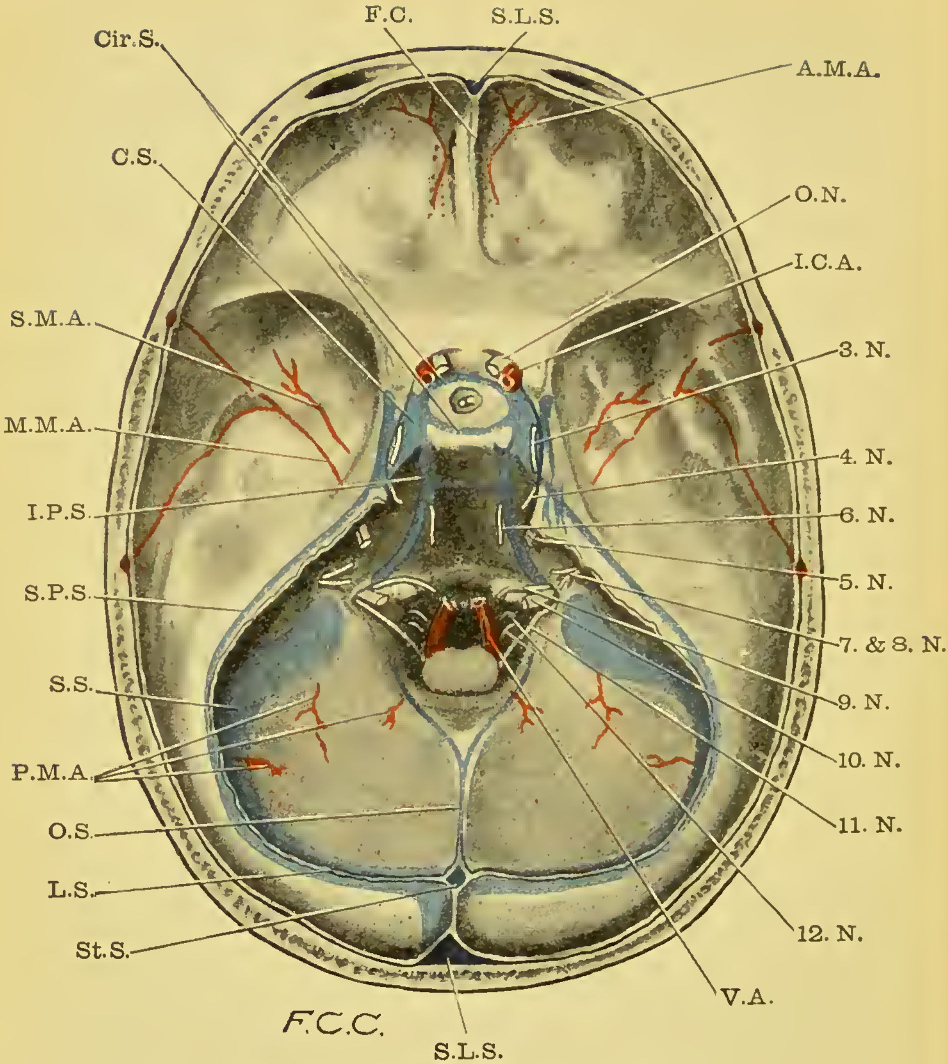


FIG. 32.—THE BASE OF THE CRANIUM.

S.L.S. Superior Longitudinal Sinus. *A.M.A.* Anterior Meningeal Artery. *O.N.* Optic Nerve. *I.C.A.* Internal Carotid Artery. 3. *N.* to 12. *N.* Various Cranial Nerves. *V.A.* Vertebral Artery. *St.S.* Straight Sinus. *L.S.* Tentorium cut close to the Lateral Sinus. *O.S.* Occipital Sinus. *P.M.A.* Posterior Meningeal Arteries. *S.S.* Sigmoid Sinus. *S.P.S.* Superior Petrosal Sinus. *I.P.S.* Inferior Petrosal Sinus joined by the Transverse Sinus to its opposite fellow. *M.M.A.* Middle Meningeal Artery. *S.M.A.* Small Meningeal Artery. *C.S.* Cavernous Sinus. *Cir.S.* Circular Sinus. *F.C.* Falx Cerebri.

Now trace the free edge of the tentorium, bounding the tentorial aperture, forwards, and notice how it crosses above the attached margin to reach the anterior clinoid process,

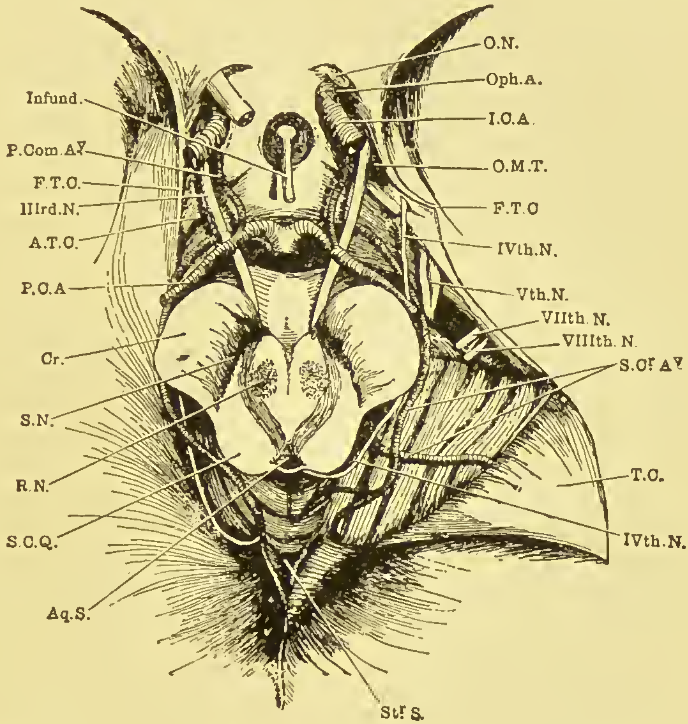


FIG. 33.—ATTACHMENT OF THE TENTORIUM CEREBELLI AFTER REMOVAL OF THE CEREBRUM.

Infund. Infundibulum. *P.Com.Av.* Posterior Communicating Artery. *III, IV, V, VII, VIII, N.* The Respective Cranial Nerves. *F.T.C.* Free Part of Tentorium. *A.T.C.* Attached Part of Tentorium. *P.C.A.* Posterior Cerebral Artery. *Cr.* Crusta. *S.N.* Substantia Nigra. *R.N.* Red Nucleus. *S.C.Q.* Superior Corpus Quadrigeminum. *Aq.S.* Aqueductus Sylvii. *Str.S.* Straight Sinus. *T.C.* Tentorium reflected. *S.Cr.Av.* Superior Cerebellar Artery. *O.M.T.* Oculo-motor Triangle. *I.C.A.* Internal Carotid Artery. *Oph.A.* Ophthalmic Artery. *O.N.* Optic Nerve.

thereby strengthening the partition. This point of crossing is the place at which the delicate *trochlear* or *fourth cranial nerve* leaves the subdural space, and the nerve should be

identified winding round the outer side of the crus cerebri, just under cover of the edge of the tentorium (see Fig. 33).

The free and attached edges of the tentorium in front of their crossing form two sides of a triangle, the base of which is a line joining the anterior and posterior clinoid processes. In the centre of this triangle, and a little external to the posterior clinoid process, is a point at which the *oculo-motor* or *third cranial nerve* pierces the dura mater.

Trace this nerve back to the inner aspect of the cut crus cerebri of its own side, and look just below it for the superior cerebellar artery running backwards from the termination of the basilar artery.

Now find the infundibulum once more, and notice that it disappears through a hole in the *diaphragma sellæ*, a process of the dura mater which roofs over the pituitary fossa. It is desirable to leave this fossa undisturbed for the present.

Lift up one of the optic nerves, and look for the *ophthalmic artery* coming off the internal carotid and lying at first below and internal to the nerve, though soon gaining a position below and external, and so disappearing with the nerve through the optic foramen.

The tentorium should now be turned back by cutting just behind its attachment to the petrous bone on each side, and also by dividing it from before backwards, close to the mid line. This exposes the upper surface of the cerebellum, and the fourth nerve may now be traced round the outer sides of the crura cerebri, lying close to the superior cerebellar arteries.

Cut these nerves with scissors, leaving a good piece in the cranium to identify them by. In the same way divide the third nerves.

Now draw the cut crura and pons gently backwards until the large *trigeminal* or *fifth cranial nerves* are seen running over the petrous bone just external to its apex.

These should be cut, but all the cranial nerves require

dividing with great care, since they have not yet gained a sheath from the dura mater, and are easily torn.

In cutting the fifth nerves notice the small motor root lying below the large sensory one.

Continue to draw back the brain until the *abducens* or *sixth cranial nerve* is seen on each side piercing the dura mater $\frac{3}{4}$ inch behind the posterior clinoid process.

Cut the sixth nerves and then look for the *facial* (*seventh*) and *auditory* (*eighth*) *nerves*, with the delicate *pars intermedia nerve* between them. Perhaps the little *auditory branch of the basilar artery* will be seen accompanying them.

When these have been divided, the *glosso-pharyngeal* (*ninth*), the *vagus* (*tenth*), and the *spinal accessory* (*eleventh cranial*) *nerves* should be found. They pass through the posterior lacerated or jugular foramen in the skull, but nothing is seen of this as long as the dura mater is in position except two small holes, the anterior of which transmits the ninth and the posterior the tenth and eleventh nerves.

It will be noticed that these three nerves pierce the dura mater from before back in the order in which they are numbered.

Between the point at which these nerves pierce the dura mater and the foramen magnum is an elevation in the floor of the skull called the *jugular tubercle.* The ninth and tenth nerves pass outward across the top of this and sometimes groove it, but the eleventh nerve will be seen arching up from the foramen magnum behind the tubercle.

The ninth and tenth nerves should be cut, but the eleventh left untouched.

The *hypoglossal* or *twelfth cranial nerve* will be found as two bundles, often some distance apart, penetrating the dura mater below and internal to the exit of the eleventh.

After these have been carefully divided, cut through the medulla at its junction with the spinal cord as nearly flush with the lower border of the foramen magnum as can be

managed. The two vertebral arteries must be cut at the same level, and then the cerebellum, pons, and the medulla may be removed and put away with the rest of the brain.

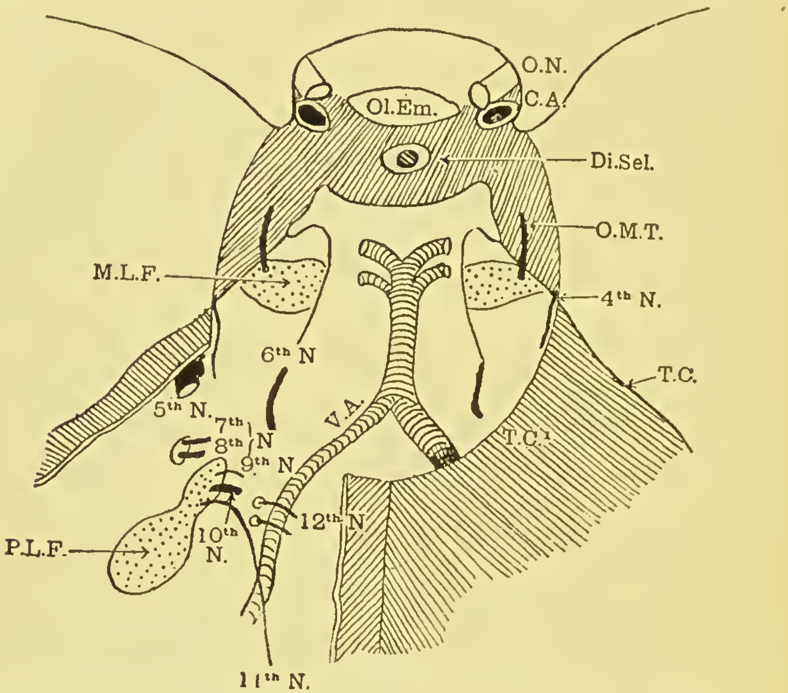


FIG. 34.—DIAGRAM OF THE RELATIONS OF THE EXITS OF THE CRANIAL NERVES THROUGH THE BASE OF THE SKULL.

O.N. Optic Nerve. *C.A.* Internal Carotid Artery. *Ol.Em.* Olivary Eminence. *Di.Sel.* Diaphragma Sellæ. *O.M.T.* Oculo-motor Triangle with 3rd Nerve. 4*th* *N.* Trochlear or 4th Nerve. *T.C.* Attached Margin of Tentorium Cerebelli. *T.C'.* Free Margin of Tentorium Cerebelli. *M.L.F.* Middle Lacerated Foramen. 5*th**N.* Trifacial or 5th Nerve. 6*th* *N.* Abducens or 6th Nerve. 7*th* and 8*th* *N.* Facial and Auditory Nerves passing into Internal Auditory Meatus. 9*th*, 10*th* and 11*th**N.* Glosso-pharyngeal Vagus and Spinal Accessory Nerves. *P.L.F.* Posterior Lacerated Foramen. 12*th* *N.* Hypoglossal Nerve in two Roots. *V.A.* Vertebral Artery.

All the twelve pairs of cranial nerves have now been seen, as far as the point at which they pierce the dura mater, with the exception of the *olfactory* or *first cranial nerves.* These are so delicate that they are seldom seen in the dis-

secting room, but an attempt should be made by lifting the olfaetory bulb whieh was left on the eribriform plate of one side to expose them. They are very numerous, but so fine and soft that they offer no resistanee to raising the bulb, and it is only for an instant, as they are stretehed before snapping, that they ean be eaught sight of.

It will be notieed that the first and second eranial nerves pieree the dura mater at praetieally the same point as that at whieh they leave the skull.

The same thing is true for the seventh to the twelfth nerves inelusive, but from the third to the sixth they have an intradural course, often of eonsiderable length, whieh should be investigated next.

It is most eonvenient to begin with the *fifth nerve* whieh passes through an oval aperture in the dura mater just above the apex of the petrous bone and below the attaehment of the tentorium. This opening leads into a definite ante-room in the dura mater, known as *Meckel's Cave.*

Explore this eavity with a seeker, slit it open, and notiee how in it the sensory braneh of the fifth expands into a flattened swelling, known as the *Gasserian ganglion* [G. semi-lunare] (see Fig. 35).

From the distal side of this ganglion three large nerves come off, giving the swelling the appearanee of a three-pronged fork, the lateral prongs of whieh are splayed out.

The inner and upper of these three nerves is the *first* or *ophthalmic division* of the fifth [N. ophthalmicus]; the middle is the *second* or *maxillary division* [N. maxillaris]; while the outer and lower is the *third* or *mandibular division* [N. mandibularis], and eaeh of them as it leaves the ganglion reeeives a strong and intimate sheath from the dura mater.

On lifting up the trunk of the fifth nerve with the ganglion, it will be seen that the small motor root [portio minor] only joins the third division, so that neither of the others ean possibly supply any museles.

The *third division of the fifth* is seen to leave the skull at the foramen ovale, the *second* should be traced forwards, embedded in the dura mater, to the foramen rotundum, while the *first division* passes forwards in the outer wall of the cavernous sinus to the sphenoidal fissure through which it enters the orbit.

Before reaching the foramen, however, it divides into three branches, *lacrimal, frontal,* and *nasal* [N. nasociliaris],

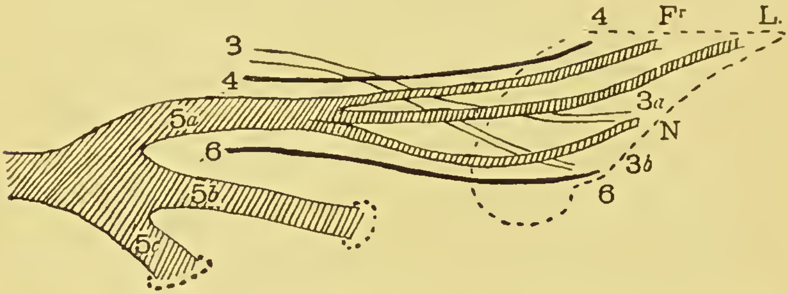


FIG. 35.—DIAGRAM OF THE NERVES IN THE OUTER WALL AND FLOOR OF THE CAVERNOUS SINUS (LOOKED AT FROM THE OUTER SIDE).

5*a*. The Ophthalmic Division of the Fifth Nerve leaving the Gasserian Ganglion. 5*b*. Maxillary Division of the Fifth Nerve. 5*c*. Mandibular Division of the Fifth Nerve. 3. Oculo-motor Nerve. 3*a* and 3*b*. Superior and Inferior Divisions entering the Orbit through the Sphenoidal Fissure. 4. Trochlearis Nerve. *Fr.* Frontal, *L.* Lacrimal, *N.* Nasal Nerves. 6. Abducens Nerve.

the identification of which will be easier when the orbit is being dissected.

In the dissection of this first division of the fifth nerve the cavernous blood sinus will probably be opened, but it is advisable to study its cavity on the opposite side rather than to run the risk of damaging the other cranial nerves which lie in its walls.

The *fourth nerve* [N. trochlearis] needs great care in its exposure; it should be picked up with the forceps at the point where the attached border of the tentorium is crossed by the free, made fairly tight, and then a knife with a really sharp point run forwards along its course, the back of the

knife being turned to the nerve. As it runs forwards it is crossed externally by the lacrimal and frontal branches of the fifth. Snipping off the anterior clinoid process on one side makes the dissection of these nerves more easy, but it must be done very carefully.

The *third nerve* [N. oculomotorius] lies internal to the fourth, and enters the cavernous sinus through its roof; thence it may be traced into the outer wall, where it lies internal to both the fourth and fifth nerves and divides into an upper and a lower branch.

The *sixth nerve* [N. abducens] has been seen leaving the subdural space three-quarters of an inch below the posterior clinoid process; it should be exposed in the way advised for the fourth nerve, and, in doing so, it will be seen to lie with the inferior petrosal sinus in a little notch at the side of the base of the dorsum sellæ. After this it runs along the floor of the cavernous sinus on the outer side of the internal carotid artery, which is also lying here. It passes at last through the sphenoidal fissure below the other nerves.

Students often find it difficult to remember the way in which these nerves cross one another in the outer wall of the sinus; it should therefore be noticed carefully that the sixth nerve is always the lowest, and that the third, fourth, and fifth always keep their numerical order from within outwards, though they only have it from above downwards in the posterior part of the sinus.

The *Cavernous Sinus* [S. cavernosus] is about an inch long, and starts at the sphenoidal fissure by receiving most of the veins from the orbit. It ends posteriorly above the apex of the petrous bone, where it is drained by the superior and inferior petrosal sinuses, but in its course it receives many veins from the front of the base of the brain, and in particular the Superficial Sylvian Vein. It is formed by a splitting of the dura mater and is lined by endothelial tissue.

It should be slit open from above on the other side to that in which the nerves have just been dissected, and then

it will be seen that the sinus gets its name from a number of filaments which run across it and form cavernous tissue.

The carotid artery and the nerves will be recognised lying in this tissue, but each surrounded by an endothelial sheath.

The inner wall is hardly present, and a seeker will show that the blood space is continuous with the so-called *circular sinus* [S. circularis], which fills up all that part of

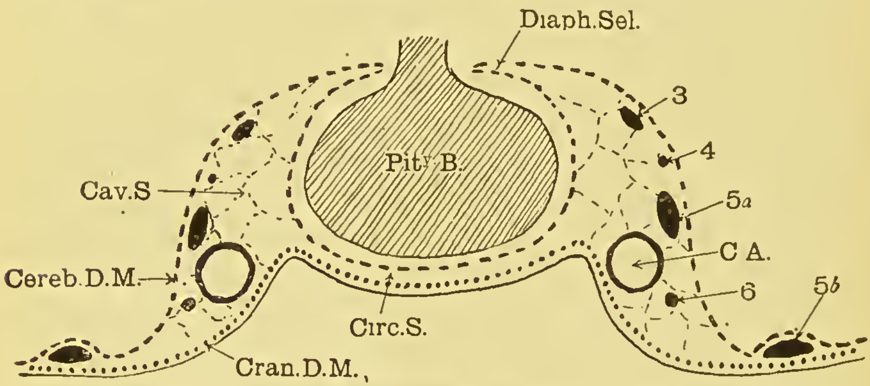


FIG. 36.—DIAGRAMMATIC SECTION THROUGH CAVERNOUS SINUS.

Pit^y.B. Pituitary Body. *Diaph.Sel.* Diaphragma Sellæ. 3, 4, and 6. Third, Fourth, and Sixth Nerves. 5*a*. Ophthalmic Division of Fifth Nerve. 5*b*. Maxillary Division of Fifth Nerve. *C.A.* Internal Carotid Artery. *Circ.S.* Circular Sinus. *Cran.D.M.* Cranial Layer of Dura Mater. *Cereb.D.M.* Cerebral Layer of Dura Mater. *Cav.S.* Cavernous Tissue in the Cavity of the Cavernous Sinus.

the pituitary fossa not occupied by the gland, and so forms a communication between the cavernous sinuses of opposite sides.

The cavernous sinus communicates with the pterygoid and pharyngeal plexuses outside the skull through the foramen ovale, middle lacerated foramen, and carotid canal, but these emissary veins are too small to be made out without special injection.

Occasionally there is an unusually large safety valve in the shape of an emissary vein passing through the *foramen Vesalii*, just internal to and in front of the foramen ovale.

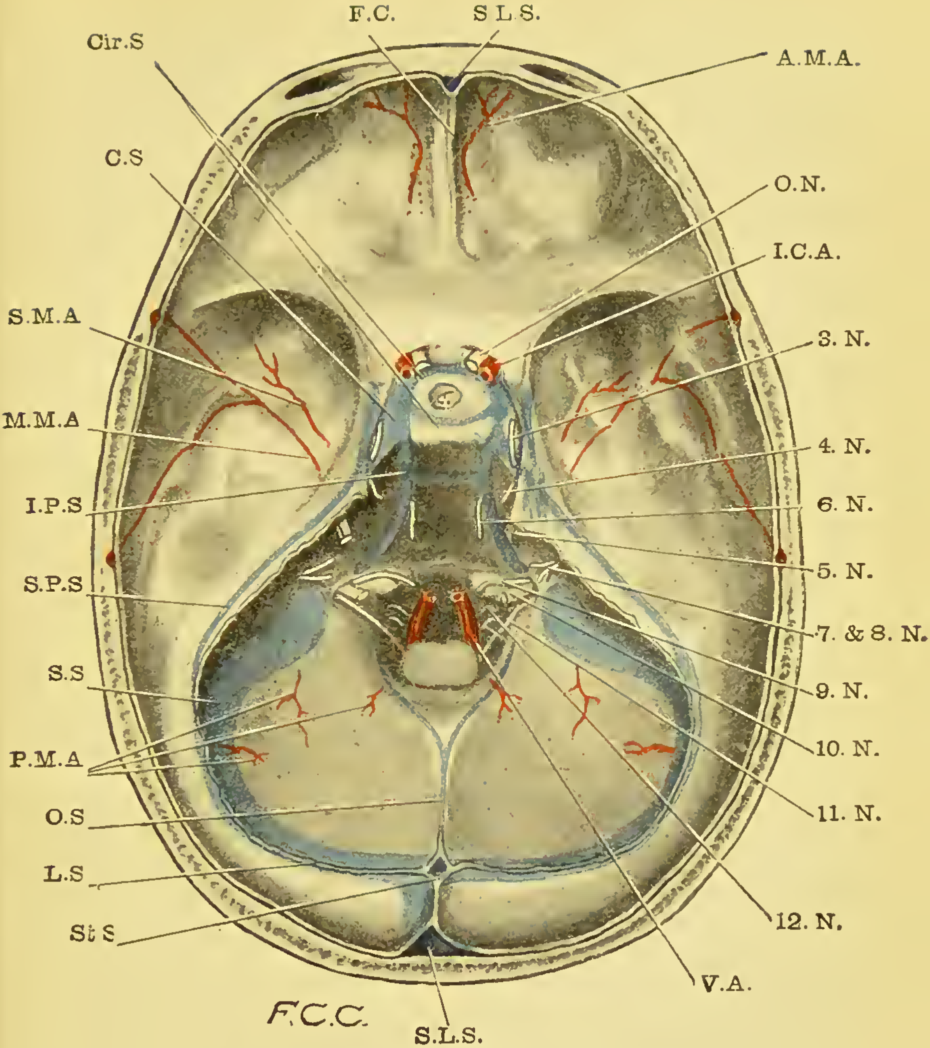


FIG. 37.—THE BASE OF THE CRANIUM.

S.L.S. Superior Longitudinal Sinus. *A.M.A.* Anterior Meningeal Artery. *O.N.* Optic Nerve. *I.C.A.* Internal Carotid Artery. 3. *N.* to 12. *N.* Various Cranial Nerves. *V.A.* Vertebral Artery. *St.S.* Straight Sinus. *L.S.* Tentorium cut close to the Lateral Sinus. *O.S.* Occipital Sinus. *P.M.A.* Posterior Meningeal Arteries. *S.S.* Sigmoid Sinus. *S.P.S.* Superior Petrosal Sinus. *I.P.S.* Inferior Petrosal Sinus joined by the Transverse Sinus to its opposite fellow. *M.M.A.* Middle Meningeal Artery. *S.M.A.* Small Meningeal Artery. *C.S.* Cavernous Sinus. *Cir.S.* Circular Sinus. *F.C.* Falx Cerebri.

From the posterior end of the cavernous sinus trace the superior and inferior petrosal sinuses, the former of which has been slit up and examined already.

The *inferior petrosal sinus* [S. petrosus inferior] is larger than the superior, and there is no sign of it in the cranial base until it is slit open, since it rests in a groove between the petrous and basioccipital bones, and is covered by the cerebral layer of the dura mater.

Find its opening from the cavernous sinus at the apex of the petrous bone, and pass a seeker backwards and outwards along it, gradually slitting it up until the posterior lacerated foramen is reached. It will be found to pass just external to the point at which the sixth nerve pierces the dura mater (see Fig. 37).

The study of the *lateral sinus* [S. transversus] may now be finished by slitting it open from behind the outer end of the petrous bone, where it is resting against the posterior inferior angle of the parietal bone at the asterion. It will be seen to run downwards and inwards with an S-shaped curve which gains for this part the name of the *sigmoid sinus.*

This part is of great importance in aural surgery, because it lies so close to the mastoid antrum and mastoid cells. It is therefore well to survey carefully its superficial landmarks, remembering that, as the right lateral sinus is usually larger than the left, it comes into closer relation with the mastoid antrum.

The *asterion* is at the postero-inferior angle of the parietal bone, and also marks the place where the horizontal part of the lateral sinus turns down to become the sigmoid sinus. To fix this point on the living head, draw a line from the lambda (which is a hand's-breadth or $2\frac{3}{4}$ inches above the external occipital protuberance) to the tip of the mastoid process; the junction of the middle and lower thirds of this line corresponds very closely to the asterion.

A line drawn from the external occipital protuberance to the asterion marks the course of the horizontal part of the lateral sinus, while the sigmoid sinus is marked by

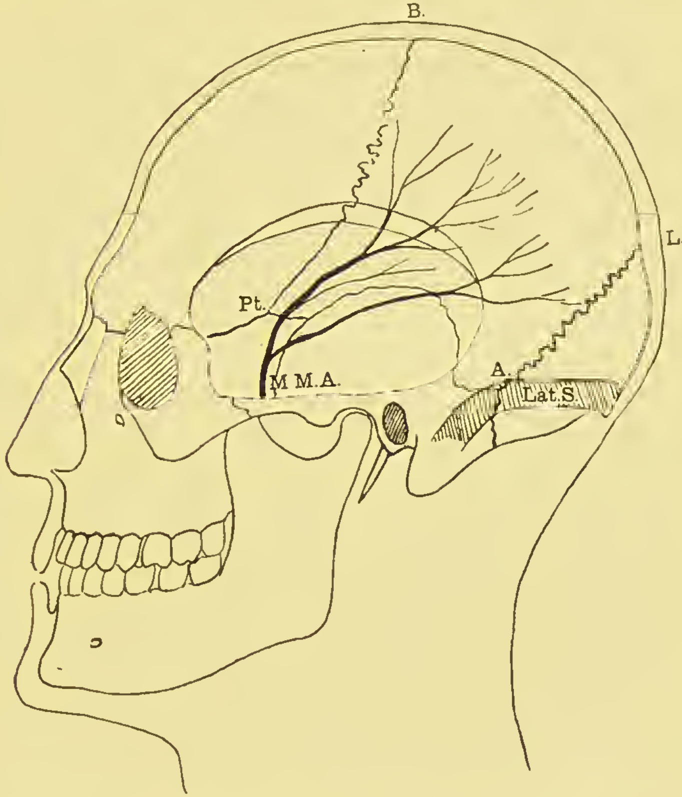


Fig. 38.—Relations of the Middle Meningeal Artery and Lateral Sinus to the Surface of the Skull.

B. Bregma. *L.* Lambda. *Pt.* Pterion. *A.* Asterion. *M.M.A.* Middle Meningeal Artery. *Lat.S.* Lateral Sinus.

a line drawn downwards and forwards towards the tip of the mastoid process, but stopping when it is on a level with the lower border of the external auditory meatus. It is a very good plan to drill some holes into the sinus at different points and to notice how the thickness of the bone increases as the sinus passes down.

A hole drilled 1 inch horizontally behind the middle of the upper margin of the external auditory meatus usually strikes the anterior part of the sinus, though it is important to realise that the exact position of the latter structure varies a good deal.

Many surgeons prefer to take the line at which the skin over the mastoid process is reflected on to the back of the auricle as a working guide to the position of the sigmoid sinus.

The interior of the sinus should be cleaned out, and its posterior wall carefully examined for the *mastoid emissary vein*, which communicates with the occipital vein through the mastoid foramen, about 1 inch below the asterion.

The foramen, though sometimes absent, is often of large size, and its emissary vein may cause serious trouble in operations about this region.

The last part of the sinus runs inwards and then turns forwards to reach the jugular foramen at its most external and posterior compartment through which it turns sharply downwards to join the inferior petrosal sinus outside the skull. This latter sinus passes through the antero-internal compartment of the foramen, while the middle compartment is occupied by the three nerves.

Of these the glosso-pharyngeal has a separate aperture in the dura mater in front of that for the vagus and spinal accessory.

In the mid line of the posterior fossa of the cranium the small *falx cerebelli* is found, continuous with the under surface of the tentorium, and having the small *occipital sinus* between its layers, where it is attached to the internal occipital crest.

Lay this sinus open and notice that, as it approaches the foramen magnum, it bifurcates, and that each branch skirts the margin of the foramen to join the lateral sinus just before its disappearance.

Above the hind margin of the foramen magnum there

is a little triangular depression in the dura mater which receives the posterior end of the vermis of the cerebellum.

The *Meningeal Arteries*, if they are fully injected, show quite well through the dura mater; it is, however, of the first importance to realise that they lie outside on the cranial aspect of that membrane.

The *anterior meningeal artery* is a branch of the anterior ethmoidal which runs across the cribriform plate from the anterior ethmoidal foramen to the nasal slit at the side of the crista galli. Dissect the dura mater from over the cribriform plate to expose this artery, which will be found running with the second intracranial portion of the *nasal nerve* (its first intracranial portion has been studied in the cavernous sinus).

The *middle meningeal artery* enters the skull at the foramen spinosum, where its close relation to the exit of the third division of the fifth nerve should be carefully noted. It runs upwards and forwards, grooving the great wing of the sphenoid as a rule. Some little distance below the pterion it divides into anterior and posterior branches, the former running up to the pterion, which corresponds to a point on the side of the living head two fingers'-breadth ($1\frac{1}{4}$ inch) above the middle of the zygoma, and then generally sinks into a tunnel in the parietal bone, so that in trephining at this point it may be unavoidably cut. The posterior branch runs back across the top of the squamous bone, and reaches the parietal about the middle of its lower border. The rest of its course was seen on first removing the skull-cap.

It may be here noted once more that the grooves in the skull usually attributed to the meningeal arteries are really formed by their accompanying veins.

Clear away some of the dura mater near the foramen spinosum in order to see this artery more clearly, and at the same time to notice how much more firmly the membrane is bound down to the base of the skull than to the vault.

The *small meningeal artery* enters the skull through the

foramen ovale, and is so small as to be often undetected; it supplies the floor of the middle cranial fossa (see Fig. 37, p. 75).

The *posterior meningeal arteries* may come from all or

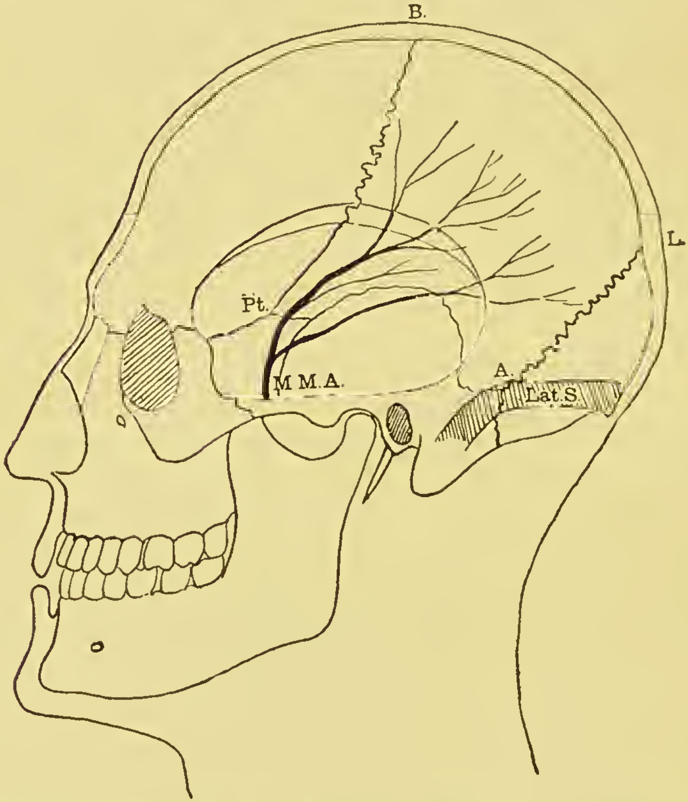


FIG. 39.—RELATIONS OF THE MIDDLE MENINGEAL ARTERY AND LATERAL SINUS TO THE SURFACE OF THE SKULL.

B. Bregma. *L.* Lambda. *Pt.* Pterion. *A.* Asterion. *M.M.A.* Middle Meningeal Artery. *Lat. S.* Lateral Sinus.

any of three sources: (1) from the ascending pharyngeal artery through the jugular foramen; (2) from the occipital through the mastoid foramen; and (3) from the vertebral before it pierces the dura mater in the cervical region.

Now lift up the Gasserian ganglion, and dissect the dura

mater away from the petrous bone, where it forms the floor of Meckel's cave. The object of this is to find the *great superficial petrosal nerve,* which comes out of the hiatus Fallopii in the petrous bone below the Gasserian ganglion to pierce the cartilage forming the middle lacerated foramen. It is, of course, outside Meckel's cave.

Just in front and below is the much smaller *small superficial petrosal nerve,* which needs very careful looking for, and generally disappears through the petro-sphenoid suture.

When the base of the skull has been carefully revised, chisel away the dorsum sellæ, and then remove the pituitary body, placing it carefully in the pot with the rest of the brain.

DISSECTION OF THE ANTERIOR TRIANGLE OF THE NECK

This triangle has for its base the lower border of the body of the mandible and a line continued back from that until the sterno-mastoid is reached; its anterior boundary is the mid line of the neck, its posterior the anterior border of the sterno-mastoid muscle, while its apex points downwards in the suprasternal notch.

Surface Anatomy.—Before beginning the actual dissection let the head fall well back and make out the following points: About two inches behind and below the chin in the mid line is the *body of the hyoid bone;* in a living person, standing up, this is almost level with the chin, horizontally, and corresponds to the third cervical vertebra behind. In a thin subject the great cornua can be felt by gripping the bone between the finger and thumb, and it is sometimes even possible to feel the lesser cornu with the index finger. It is a great advantage to explore landmarks in the living as well as in the dead subject, and to remember that the index finger of the right hand is the one which has had most education and experience. The pressure should be

very slight at first and gradually increased until the structure is felt, while during the whole process the explorer should try to visualise the outlines of the part under examination and, if necessary, compare them with a dry specimen.

About a finger's-breadth below the body of the hyoid is the *pomum Adami* or anterior extremity of the thyroid

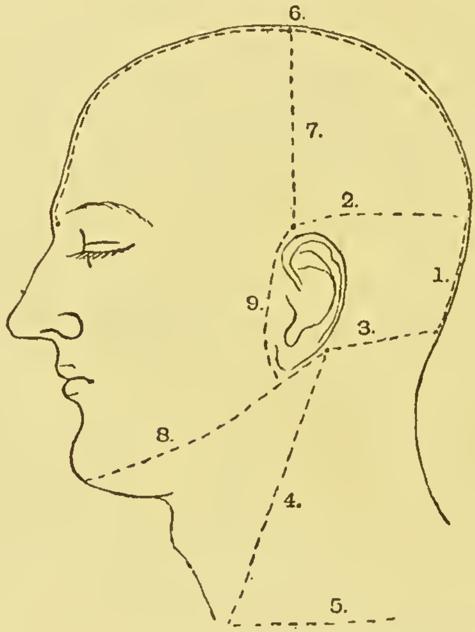


FIG. 40.—SKIN INCISIONS FOR THE DISSECTION OF THE HEAD AND NECK.

cartilage, more prominent in adult males than in females or children, and the movements of this should be felt in a living person while swallowing. Between the two structures is the *thyro-hyoid space*, and the upper border of the thyroid cartilage may be explored for a little distance, but is soon obscured by the sterno-hyoid muscles. This is the spot which suicides generally choose for cutting their throats.

About an inch below the pomum Adami is the *cricoid cartilage*, marking the lower limit of the larynx and corresponding to the sixth cervical vertebra, while the top of

the thyroid is opposite the fourth. Between the cricoid and thyroid is the *crico-thyroid space,* and here the larynx may be opened in any sudden emergency requiring the admission

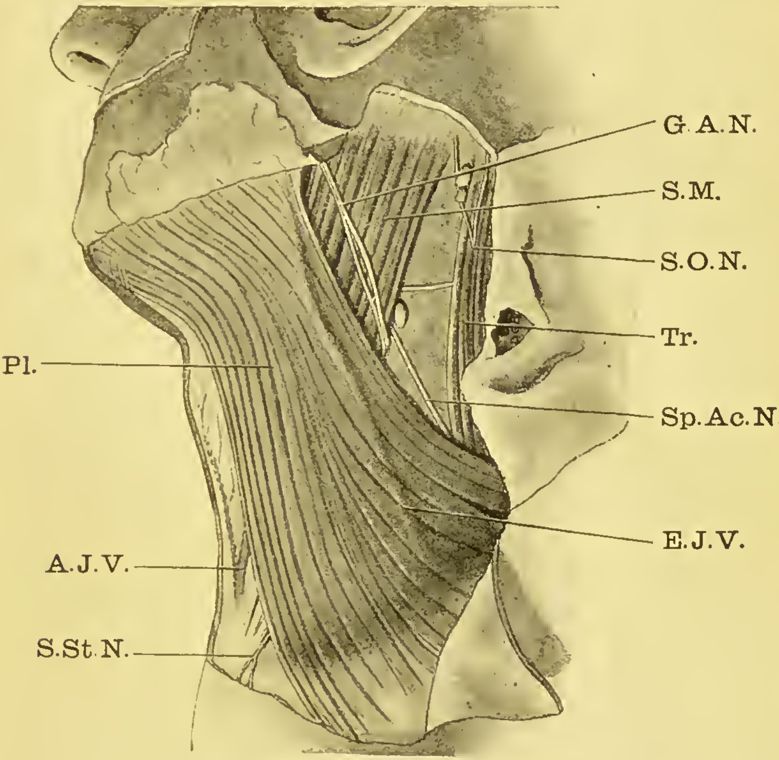


FIG. 41.—THE PLATYSMA MUSCLE AND ITS RELATIONS.

Pl. Platysma. *A.J.V.* Anterior Jugular Vein. *S.St.N.* Suprasternal Nerve. *E.J.V.* External Jugular Vein, seen through the Platysma. *Sp.Ac.N.* Spinal Accessory Nerve. *Tr.* Trapezius. *S.O.N.* Small Occipital Nerve (in this case piercing some of the fibres of the Trapezius). *S.M.* Sterno-mastoid Muscle. *G.A.N.* Great Auricular Nerve.

of air below the true vocal cords. This is the operation of "laryngotomy." A little below the cricoid is the soft *isthmus of the thyroid body* lying just above the suprasternal notch, and, when the head is thrown back, some of the rings of the trachea may be felt below it on deep pressure. It must be

remembered that in women and children the subcutaneous fat is more plentiful than in adult males, and therefore palpation in them is more difficult. The outline of the sterno-mastoid

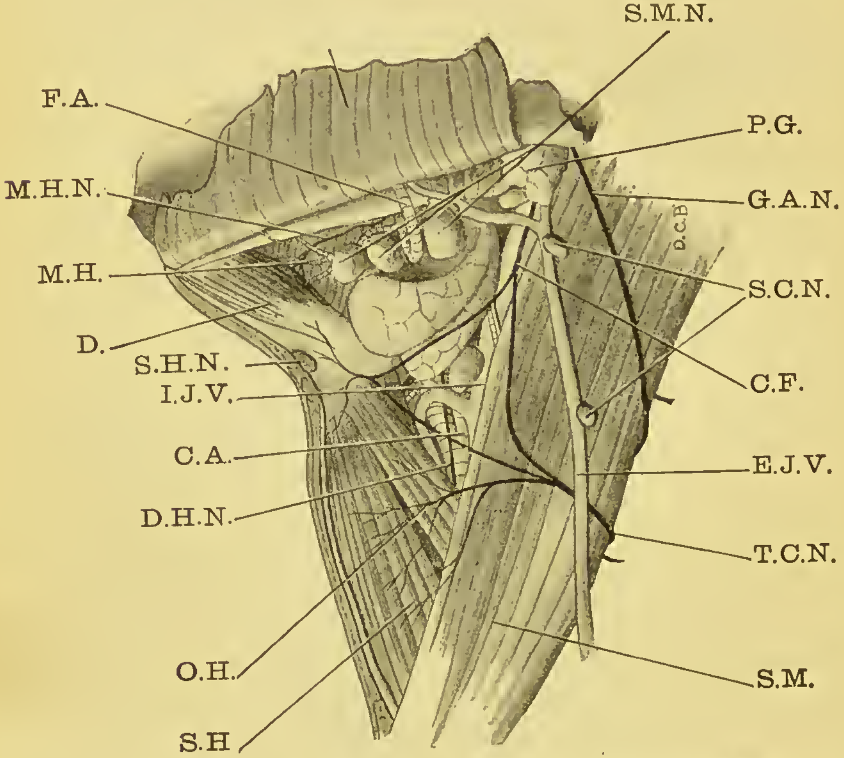


FIG. 42.—DISSECTION OF THE ANTERIOR TRIANGLE OF THE NECK.

S.M.N. Submaxillary Nodes. *P.G.* Parotid Gland. *G.A.N.* Great Auricular Nerve. *S.C.N.* Superficial Cervical Nodes. *C.F.* Cervical branch of Facial Nerve. *E.J.V.* External Jugular Vein. *T.C.N.* Transverse Cervical Nerve. *S.M.* Sterno-mastoid. *S.H.* Sterno-hyoid. *O.H.* Omo-hyoid. *D.H.N.* Descendens Hypoglossi Nerve. *C.A.* Bifurcation of Common Carotid Artery. *I.J.V.* Internal Jugular Vein. *S.H.N.* Suprahyal Lymph Node. *D.* Digastric. *M.H.* Submental Branch of Facial Artery lying upon Mylo-hyoid Muscle. *M.H.N.* Mylo-hyoid Nerve. *F.A.* Facial Artery.

in the living body is made more distinct by turning the face to the opposite side, and the index finger can usually be pushed deep to the cord-like sternal origin of the muscle.

DISSECTION.—An incision (No. 4, Fig. 40) has already

been made down the surface of the sterno-mastoid, so that it is only necessary to make a horizontal one along the lower border of the body of the lower jaw and to carry it back until it meets the first close to the tip of the mastoid process (Incision No. 8, Fig. 40). The triangular flap of skin should then be turned forwards. This must be done carefully to avoid injury to the thin platysma sheet which runs downwards and backwards from the muscles of the lower lip to pass superficial to the clavicle. Below the chin it will be noticed that the platysma muscles of opposite sides decussate across the mid line, but, as they descend, their anterior borders diverge (see Fig. 41).

Through the platysma the *external jugular vein* already dissected in the posterior triangle can be seen, accompanied by some small superficial lymphatic nodes. The *great auricular* and *transverse cervical nerves* are also seen winding round the posterior border of the sterno-mastoid, while, near the mid line, the anterior jugular vein runs down from the region beneath the chin. Between the chin and the hyoid bone, on each side of the mid line, is a small *suprahyoid lymphatic node* which drains the lower lip and chin region and is of considerable clinical importance (see Fig. 42, S.H.N.). Now reflect the platysma from below upwards, and in doing so look for the *cervical branch of the facial nerve* [ramus colli], which runs down just behind the angle of the jaw to join twigs of the transverse cervical nerve, and so supply the muscle.

Deep to the platysma is the ensheathing layer of the *deep cervical fascia*, which is usually described as splitting to form a sheath for the sterno-mastoid. The dissector must not expect to see a definite sheet of dense fascia like the fascia-lata in the thigh. A little close observation will convince him that all the interstices between the structures in the neck are filled in with cellular tissue containing a variable amount of fat in its meshes, and that all the fascial planes are merely slight condensations of this. It should be

noticed too that cellular tissue, when dissected away from its attachments, condenses into an artificial sheet which is not present at all during life. Just above the suprasternal notch the cellular tissue is very plentiful and is known as *Burns' "space."* Here the ensheathing layer of the deep cervical fascia is said to split, though no evidence of any such thing is present in a median section unless it has been specially prepared to show it. Above, the deep cervical fascia is usually described as being attached to the lower jaw, the hyoid bone, and, by splitting, to form a bag in which the parotid gland is lodged, while below it is attached to the clavicle.

This description is true enough except that it suggests a sharp distinction between the deep fascia, the superficial fascia, and the intermuscular septa, whereas all these structures are quite continuous and all consist of cellular tissue containing more or less fat.

Now clear away this tissue in the lower part of the anterior triangle, and so expose the lower of the three small triangles into which it is subdivided.

This is called the MUSCULAR TRIANGLE, and its boundaries are the mid line of the neck in front, the anterior belly of the omo-hyoid above, and the edge of the sterno-mastoid behind (see Fig. 43).

The *omo-hyoid* can be readily recognised by pulling on its posterior belly already exposed in the posterior triangle; it runs downwards and outwards from the lower border of the hyoid bone, at the junction of its body and great cornu, to disappear deep to the sterno-mastoid about the level of the cricoid cartilage. Clear the cellular tissue away from the upper part of the anterior triangle and define the *posterior belly of the digastric* muscle.

This runs from the mastoid process to the base of the great cornu of the hyoid bone. As it nears the hyoid it narrows into its central tendon, which usually pierces the stylo-hyoid muscle. Whether it does so or not the *stylo-*

hyoid will be found running parallel with, and just in front of, the posterior belly of the digastric, and its insertion into the outer border of the base of the great cornu of the hyoid bone can be made out.

The central tendon of the digastric is partly kept down by a thickened loop of cellular tissue or cervical fascia, and

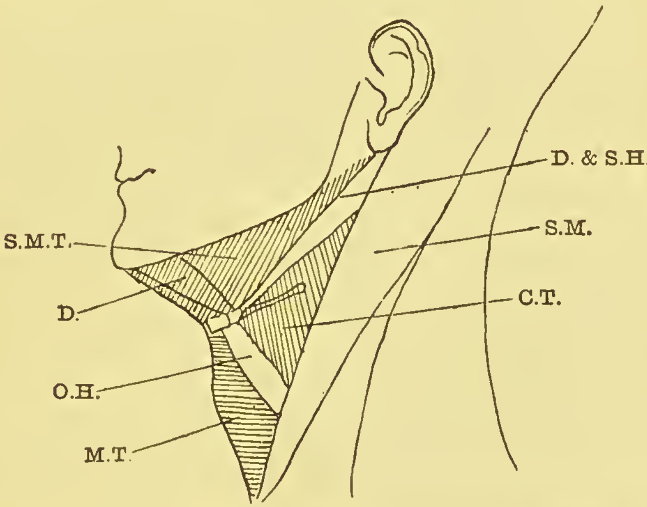


FIG. 43.—DIAGRAM TO SHOW THE SUBDIVISION OF THE ANTERIOR TRIANGLE OF THE NECK.

S.M.T. Submaxillary Triangle. *D. & S.H.* Posterior Belly of Digastric and Stylo-hyoid Muscles. *D.* Anterior Belly of Digastric (this, it will be noticed, is not a boundary of the triangle). *C.T.* Carotid Triangle. *S.M.* Sterno-mastoid. *O.H.* Omo-hyoid. *M.T.* Muscular Triangle.

partly by some of its own fibres, which are inserted into the outer border of the base of the great cornu of the hyoid bone.

The *anterior belly of the digastric* is shorter than the posterior, and runs from the digastric fossa, near the symphysis of the mandible, to the central tendon.

The triangle between the two bellies of the digastric and the lower border of the jaw is filled by the *submaxillary gland*, embedded in which, close to the place where the

facial vein leaves the face, one or two lymphatic nodes [lymphoglandulæ submaxillares] should be looked for at once (see Fig. 42, S.M.N.).

The whole plan of the artificial subdivision of the anterior triangle is now plain.

The LOWER or MUSCULAR TRIANGLE (Fig. 43, M.T.) has been seen; the MIDDLE or CAROTID TRIANGLE (C.T.) is bounded by the anterior belly of the omo-hyoid below, the sterno-mastoid behind, and the posterior belly of the digastric above, while the UPPER or SUBMAXILLARY TRIANGLE (S.M.T.) is marked out by a line drawn along the posterior belly of the digastric and continued along the hyoid bone to the mid line of the neck—this is the lower boundary—then along the mid line of the neck to the chin for the anterior limit, and above by the lower margin of the jaw and a line drawn back from its angle to the sterno-mastoid.

As the most important structures in the neck, from an anatomical point of view, are the CAROTID ARTERIES [A. carotis], their branches and relations, a careful dissection of these from below upwards will lead to a good working knowledge of this region.

The line of the *common* and *external carotid arteries* in the undissected body is one drawn from the sterno-clavicular joint to the angle of the jaw. As far as the upper border of the thyroid cartilage, the line corresponds to the common carotid artery; above that to the external carotid. The line for the internal carotid is a little posterior or external to that for the external carotid.

The plan advised for the study of the third part of the subclavian artery (see p. 39) should be adopted here, and the following relations looked for and verified.

ANTERIOR RELATIONS OF THE COMMON CAROTID ARTERY

Bones.—Sternal end of Clavicle.
Muscles.—(1) Sterno-mastoid. (2) Sterno-hyoid. (3)

Sterno-thyroid. (4) Omo-hyoid. (5) Platysma (largely indirect).

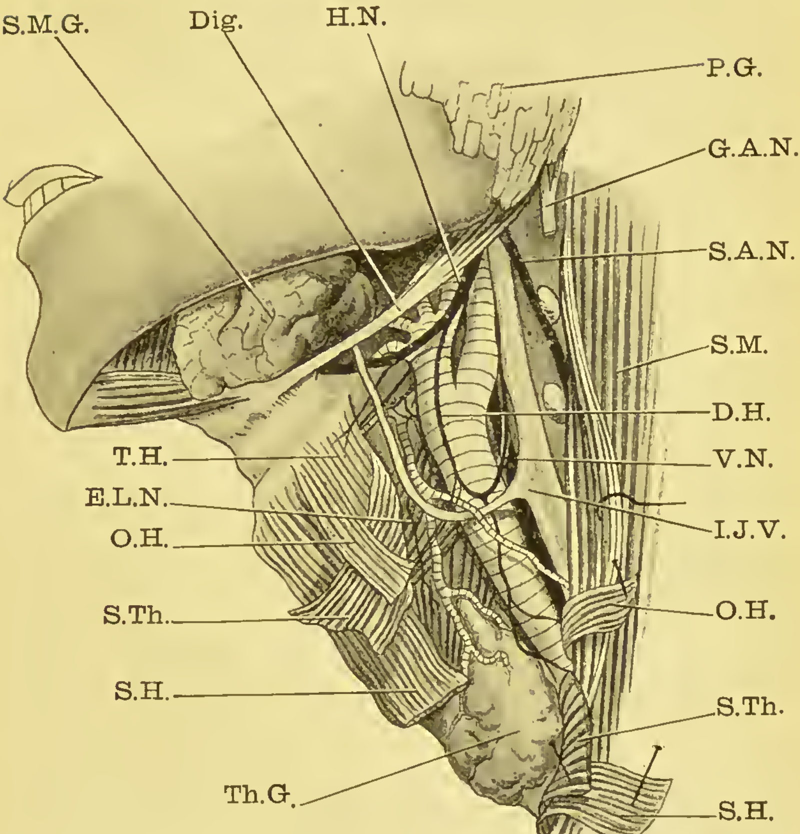


Fig. 44.—Dissection of the Carotid Arteries in the Neck.

P.G. Parotid Gland. *G.A.N.* Great Auricular Nerve. *S.A.N.* Spinal Accessory Nerve. *S.M.* Sterno-mastoid. *D.H.* Descendens Hypoglossi Nerve. *V.N.* Vagus Nerve. *I.J.V.* Internal Jugular Vein. *O.H.* Omo-hyoid. *S.Th.* Sterno-thyroid. *S.H.* Sterno-hyoid. *Th.G.* Thyroid Gland. *E.L.N.* External Laryngeal Nerve. *T.H.* Thyro-hyoid Muscle and Nerve. *S.M.G.* Submaxillary Gland. *Dig.* Digastric Tendon. *H.N.* Hypoglossal Nerve.

Fibrous Structures.—(1) Posterior part of Capsule of Sterno-clavicular joint. (2) Cervical cellular tissue forming so-called carotid sheath.

Arteries.—Superior Thyroid Artery and its sterno-mastoid branch.

Veins.—(1) Superior Thyroid. (2) Middle Thyroid. (3)

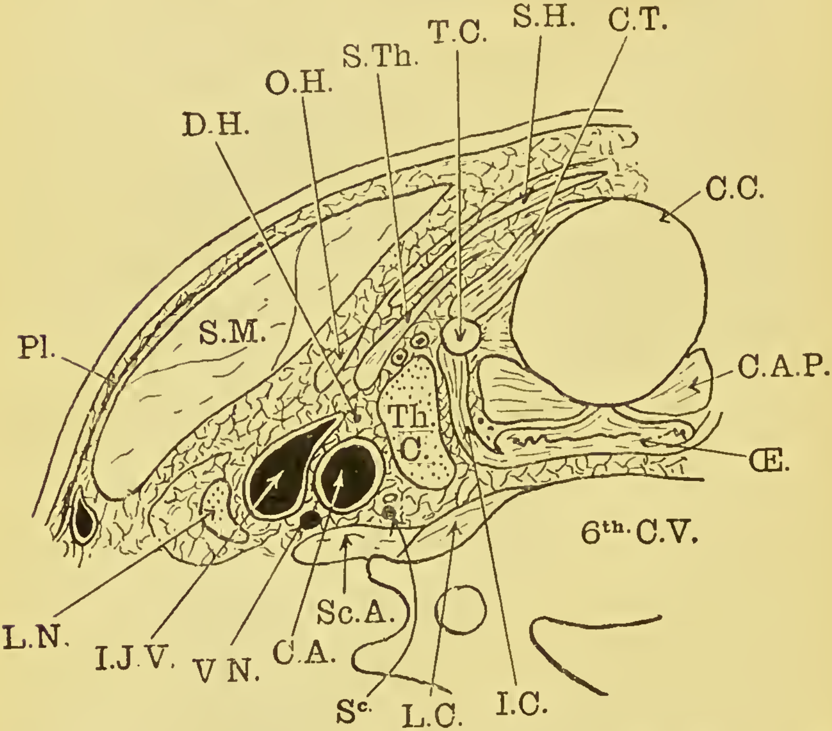


Fig. 45.—Diagram of a Freshly-cut and Undisturbed Section of the Neck.

C.T. Crico-thyroid Muscle. *S.H.* Sterno-hyoid Muscle. *T.C.* Inferior Cornu of Thyroid Cartilage. *S.Th.* Sterno-thyroid Muscle. *O.H.* Omo-hyoid Muscle. *D.H.* Descendens Hypoglossi Nerve. *S.M.* Sterno-mastoid Muscle. *Pl.* Platysma. *L.N.* One of the Deep Cervical Lymph Nodes. *I.J.V.* Internal Jugular Vein. *V.N.* Vagus Nerve. *C.A.* Common Carotid Artery. *Sc.A.* Scalenus Anticus Muscle. *Th.C.* Thyroid Gland. *Sc.* Sympathetic. *L.C.* Longus Colli. *I.C.* Inferior Constrictor. *Œ.* Œsophagus. *C.A.P.* Crico-arytenoideus Posticus. *C.C.* Cricoid Cartilage.

Anterior Jugular. (Sometimes Lingual and Facial Veins.)

Nerves.—Descendens Hypoglossi and Ansa Cervicis.

Glandular and other Structures.—Thyroid and Parathyroid Glands.

The Cervical Fascia has already been referred to, and will have to be again. It is extremely difficult for the student to get a fair idea of it from his dissection, and so he visualises it from the diagrams which his text-books provide. As long as he clearly understands that these are much more preeise and definite than anything he is likely to find in nature, they may be a help. If he does not understand this, they are misleading. A elean fresh section aeross the neck shows that all the interstiees between the various structures are filled with loose cellular tissue. When these struetures are separated by traction or by the knife, the cellular tissue collapses into sheets where no sheets had been before. It is, for example, impossible to demonstrate without artificial manipulation a definite carotid sheath in the shape of a fibrous tube. The vessels are just packed in by cellular tissue, which will collapse into a tube on disseetion, and, although the artery has just as much or just as little of a cellular sheath as any other artery of its own size, the internal jugular vein and vagus nerve have no special sheath at all unless it is artifieially made.

In describing the cervical fascia, it is usual to speak of the ensheathing layer splitting to enclose the sterno-mastoid and trapezius, and of two transverse septa passing vertically across the neck. Of these the anterior or *pretracheal septum* is said to pass between the sterno-hyoid and thyroid muscles in front and the trachea behind, while the posterior or *prevertebral septum* is said to pass behind the œsophagus.

Laterally, deep to the sterno-mastoid, these three parts, the ensheathing, the pretraeheal, and the prevertebral, are described as uniting, and where they do so they all help in forming the so-called earotid sheath, a vertical tube enclosing the common earotid artery, the internal jugular vein, and the vagus nerve.

In trying to understand things in nature as they really are, it is most important that every student should get into the way of using his own eyes and trusting to them, and if he cannot see the things described, he should ask to have

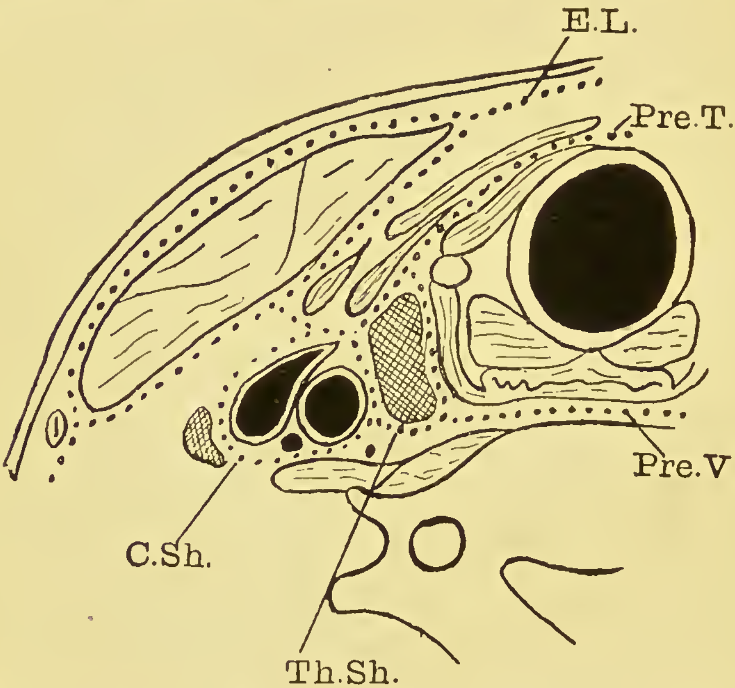


FIG. 46.—DIAGRAMMATIC SECTION THROUGH THE NECK, ADAPTED FROM FIG. 45, TO SHOW THE LAYERS OF DEEP CERVICAL FASCIA USUALLY DESCRIBED.

E.L. Ensheathing Layer. *Pre.T.* Pretracheal Layer. *Pre.V.* Prevertebral Layer. *Th.Sh.* Thyroid Sheath. *C.Sh.* Carotid Sheath. For other structures see Fig. 45.

them demonstrated, and should watch the method of demonstration without prejudice.

In the case of the cervical cellular tissue there is no difficulty in producing the orthodox arrangement from a section with a little manipulation, but there is also no difficulty, if the dissector so wishes, in making very definite planes in places where none have ever been described.

The writer's experience makes him wish that the cervical fascia could be described merely as cellular tissue packing in all the interstices of the neck, and tending to become slightly less dense where movement is most free, and he cannot find that there is any justification, from a clinical point of view, in burdening the student's memory with the usual academic description of the cervical fascia.

Having identified all the other relations, they may be cleaned and systematically examined. Leaving the clavicle and sterno-clavicular joint for examination at another time, the first important structure is the *sterno-cleido-mastoid muscle.* Its strong but small tendinous origin from the upper part of the front of the manubrium sterni has been seen in Burns' space, while its origin from the inner third of the upper surface of the clavicle can be easily made out by cleaning away the "deep cervical fascia" covering the muscle. The insertion into the mastoid process and outer two-thirds of the superior curved line of the occipital bone can be followed, and it will be seen that those fibres which rise from the sternum are inserted most superficially. While cleaning the surface of the muscle the *external jugular vein* can be followed up to its formation by the posterior auricular joining the posterior division of the temporo-maxillary veins, though it is liable to a good deal of variation. The *great auricular* and *transverse cervical nerves,* already partly dissected, may now be exposed in their whole course, and it will be seen that the former supplies the skin of the lower part of the ear as well as of an area just in front and behind it, while the transverse cervical is the cutaneous nerve of the whole of the side of the neck. The entrance of the *spinal accessory nerve* into the sterno-mastoid is deep to the anterior border of the muscle and about the level of the angle of the jaw. It is not, however, advisable to cut the sterno-mastoid yet.

The *Sterno-hyoid* and *Sterno-thyroid* muscles are only in front of the carotid artery in the lower part of the neck, and as the sterno-thyroid is the deeper of the two, it is by far

the more important relation. The origin of these muscles from the back of the manubrium sterni cannot be seen at present, but the whole of the length of the sterno-hyoid is quite evident, and should be dissected up to its insertion into the lower border of the body of the hyoid bone. As it runs up, its inner border gradually approaches that of its fellow of the opposite side, while the inner borders of the two sterno-thyroids diverge so that an elongated lozenge-shaped space is left in the mid line in which the trachea, the isthmus of the thyroid gland and the larynx are exposed. Now cut and reflect the sterno-hyoid, looking out carefully for its nerve, which enters it rather low down. The insertion of the sterno-thyroid is now visible, and is seen to be into the oblique line of the thyroid cartilage. Be careful to find its nerve, and look for a possible communication between this and the phrenic nerve.

The anterior attachment or insertion of the *omo-hyoid* muscle, just at the side of that of the sterno-hyoid, should now be made out, and the point where the muscle or its tendon crosses the carotid artery determined. It is usually about the level of the cricoid cartilage.

Notice too that the central tendon of the omo-hyoid is only bound down to the back of the clavicle and first rib by a slightly thickened loop of the deep cervical fascia, and not, as in the case of the digastric, by some of its own fibres.

The *Sterno-mastoid branch of the superior thyroid artery* is a mere muscular twig and of no practical importance.

The *Superior thyroid Vein* [V. thyreoidea superior] returns the blood from the upper part of the thyroid gland and larynx to the internal jugular vein ; it often joins the common facial vein before opening.

The *Middle thyroid Vein* crosses in front of the common carotid lower down, to open into the internal jugular, but it is often wanting.

Now look for the *descendens hypoglossi nerve* [ramus descendens hypoglossi], running down in front of the common

carotid artery and bound to it by loose connective tissue, the so-called carotid sheath. The nerve is about the size of

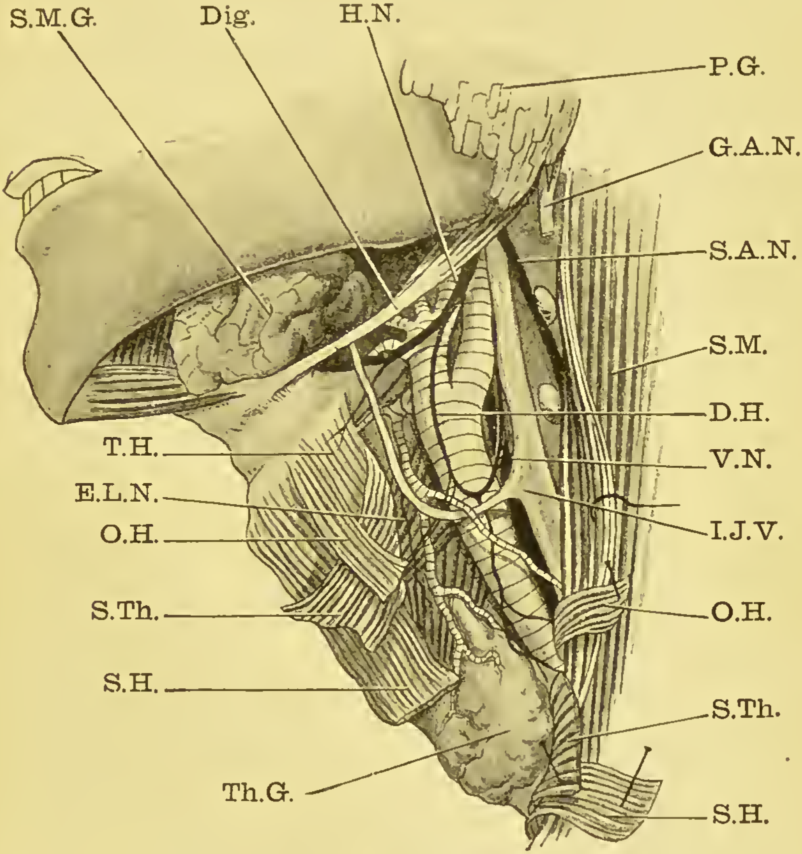


Fig. 47.—Dissection of the Carotid Arteries in the Neck.

P.G. Parotid Gland. *G.A.N.* Great Auricular Nerve. *S.A.N.* Spinal Accessory Nerve. *S.M.* Sterno-mastoid. *D.H.* Descendens Hypoglossi Nerve. *V.N.* Vagus Nerve. *I.J.V.* Internal Jugular Vein. *O.H.* Omohyoid. *S.Th.* Sterno-thyroid. *S.H.* Sterno-hyoid. *Th.G.* Thyroid Gland. *E.L.N.* External Laryngeal Nerve. *T.H.* Thyro-hyoid Muscle and Nerve. *S.M.G.* Submaxillary Gland. *Dig.* Digastric Tendon. *H.N.* Hypoglossal Nerve.

thin twine, and, when found, should be followed with great care, in order to avoid cutting the twig to the anterior belly of the omo-hyoid which it gives off.

On dissecting it up it will be seen to come off the hypoglossal nerve where that structure is crossing superficial to the beginning of the external carotid artery, just above the level of the great cornu of the hyoid bone. Below, about the level of the cricoid cartilage, it is joined by the *ramus communicans cervicis* to form a loop, the *Ansa Hypoglossi aut cervicis,* from which branches are given off to the sterno-hyoid, sterno-thyroid, and posterior belly of the omo-hyoid, all of which nerves have been seen already. It must be remembered that although the descendens hypoglossi seems to be given off from the hypoglossal, it is really derived from the first cervical nerve, and is only bound up with the hypoglossal.

The *communicans cervicis,* if followed up, will usually be seen to pass between the carotid artery and internal jugular vein, and, by separating these, the two branches which form it may be traced to the second and third cervical nerves. Sometimes, however, the nerve passes superficial to the internal jugular vein (see Fig. 50).

After dividing the sterno-hyoid and thyroid muscles the THYROID GLAND [G. thyreoidea] should be examined. It is one of the ductless glands, and has two lobes connected in front of the upper two or three tracheal rings by an *isthmus.* In cleaning it be careful not to cut its arteries and veins.

At the upper part of each lateral lobe the *superior thyroid artery* enters, usually in three branches, two anterior and one posterior, while at the lower and back part of each lobe several branches of the *inferior thyroid artery* supply it.

Occasionally a third artery, the *thyroidea ima,* ascends in front of the trachea to supply the region of the isthmus, and when this is present it is a dangerous obstacle in tracheotomy. It is generally a branch of the innominate. The anastomosis across the isthmus is sometimes fairly free, though usually there is little blood lost in a median section of this during life.

Notice that the cervical cellular tissue surrounds the gland, and is especially plentiful below; it forms what is often spoken of as the sheath of the gland.

The superior and middle thyroid veins have already been seen. The *Inferior Thyroid Vein* runs down with its fellow of the opposite side in front of the trachea, and the two veins often form a plexiform anastomosis before they unite to open into the left innominate vein. In following these down, the front of the *trachea* in its cervical course will be exposed, and it should be noticed how much further from the surface this tube gets as it goes down, and how greatly its length is increased by throwing back the head.

In cleaning the front of the trachea one or two small pretracheal lymph nodes should be looked for.

Sometimes from the isthmus of the thyroid a *pyramidal lobe* of glandular tissue ascends towards the hyoid bone; it is generally a little to one side of the middle line.

One half of the thyroid gland may be extirpated, and in doing this a little more cutting will be required at the back of each lateral lobe, near the first ring of the trachea, than elsewhere.

Just behind this point the *recurrent laryngeal nerve* [N. recurrens] is situated among the branches of the inferior thyroid artery.

Every student who wishes to become a good surgical and medical anatomist should attend the post-mortem room frequently and check his own dissection by the large and varied amount of material which is to be seen there. In this region he should especially notice how often the left innominate vein lies above the level of the supra-sternal notch in the child, and how easily it might be cut in the neck. He should also notice that in the child the top of the thymus gland often comes up into the lower part of the neck.

There are two small *Parathyroid Glands* on each side embedded in the thyroid. Though they are seldom seen

in the dissecting-room, they are of great physiological interest. The best way to see them is to get the thyroid larynx and trachea of a young child from the post-mortem room, put it at once into formalin, and next day dissect the region where the inferior thyroid arteries enter the gland. Just above and just below these arteries the little glands are found, and may often be distinguished by a slight difference in their colour from that of the thyroid.

On the outer side of the common carotid artery lies the INTERNAL JUGULAR VEIN [V. jugularis interna], which should be cleaned and examined as high as the place where it is crossed by the posterior belly of the digastric and stylo-hyoid. If it is filled with coagulated blood, as it often is in a subject injected with formalin, it is very likely to overlap the artery in the lower part of the neck, especially on the left side (see Fig. 50, p. 104).

The sterno-mastoid muscle quite hides the vein and must be drawn aside, and then the deep cervical lymphatic nodes [Lymphoglandulæ cervicales profundæ] should be very carefully dissected and noted because of their clinical importance. The largest and most important of these lie on the outer side of the vein, though a few may be found on the inner side (see Fig. 45, L.N.).

In the lower part of the neck the vein passes behind the inner end of the shaft of the clavicle, and it is very important to remember that, *on the left side*, the thoracic duct lies immediately behind the lower inch of it, so that this region should not be interfered with at present.

The superior and middle thyroid tributaries are those most likely to enter the internal jugular in the part exposed.

The *Tenth Cranial* or *Vagus Nerve* lies external to the common carotid artery as well as posterior, and can easily be found by separating the internal jugular vein from the artery.

Try to find its *cardiac branches* [rami cardiaci], which are very small and run down close to its trunk.

The Internal Relations of the Common Carotid Artery are:—

Bones.—None.

Muscles.—Inferior Constrictor, Œsophagus.

Fibrous Structures.—Cellular tissue forming inner part of carotid sheath.

Arteries.—Inferior Thyroid.

Veins.—None of special interest.

Nerves.—Recurrent Laryngeal.

Other Structures.—Larynx and Trachea.

The *Inferior constrictor* [M. constrictor pharyngis inferioris] may just be seen as it passes back from the thyroid and cricoid cartilages, but its detailed examination should be left till later.

The *Œsophagus* should be identified lying behind and slightly to the left of the trachea. Notice its appearance in a section through the 7th Cervical or 1st Thoracic vertebra, and also that the easiest way to reach it in the living body would be behind the left sterno-mastoid and carotid artery (see Fig. 48).

The *Inferior Thyroid artery* [A. thyreoidea inferior] has been dissected already in connection with the thyroid gland. The *recurrent laryngeal* nerve should be looked for in the groove between the trachea and œsophagus. On the side on which half the thyroid gland has been removed its upper end has probably already come into view.

The Larynx is best left for future investigation, but as much of the Trachea as is exposed should be carefully investigated. If the neck of a living person be felt while the face is looking forward, it will be found that there is only about an inch from the cricoid cartilage to the supra-sternal notch; that is to say, the cervical trachea is only about an inch in length, but when the head is tilted back as far as it will go the length of the cervical trachea is nearly doubled.

It has already been noticed that the anterior relations of the tube in the neck are:—

Muscles.—Sterno-hyoid and Sterno-thyroid.

Fibrous Structures.—Cervical Cellular Tissue.

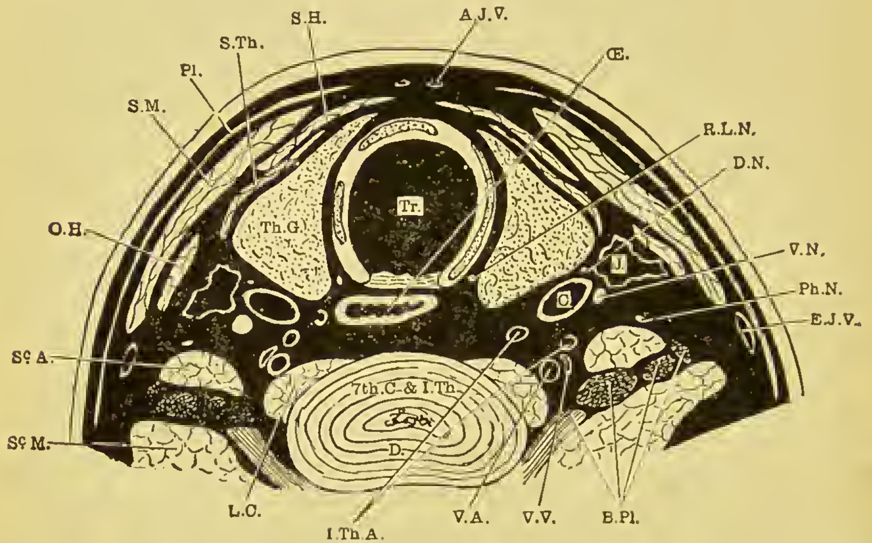


FIG. 48.—SECTION THROUGH THE NECK AT THE DISC BETWEEN THE SEVENTH CERVICAL AND FIRST THORACIC VERTEBRA (TRACED WITH THE DIAGRAPH).

Sc.M. Scalenus Medius. *Sc.A.* Scalenus Anticus. *O.H.* Omo-hyoid. *S.M.* Sterno-mastoid. *Pl.* Platysma. *S.Th.* Sterno-thyroid. *S.H.* Sterno-hyoid. *A.J.V.* Anterior Jugular Vein. *Tr.* Trachea. *Th.G.* Thyroid Gland. *Œ.* Œsophagus. *R.L.N.* Recurrent Laryngeal Nerve. *D.N.* Descendens Hypoglossi Nerve. *J.* Internal Jugular Vein. *C.* Common Carotid Artery. *V.N.* Vagus Nerve. *Ph.N.* Phrenic Nerve. *E.J.V.* External Jugular Vein. *B.Pl.* Brachial Plexus. *V.V.* Vertebral Vein. *V.A.* Vertebral Artery. *I.Th.A.* Inferior Thryoid Artery (its loop has just been cut). *L.C.* Longus Colli.

Arteries.—Thyroidea ima when present and sometimes the innominate at the root of the neck.

Veins.—Anterior Jugular, Inferior Thyroid, and sometimes the Left Innominate.

Glandular and other Structures.—Isthmus of the Thyroid Gland and some Pretracheal Lymph Nodes.

Dissection of the External Carotid Artery

The next dissection is to follow up the external carotid artery and its branches, by doing which the structures in the upper part of the neck will be met and can be investigated.

The *common carotid artery* bifurcates about the level of the upper border of the thyroid cartilage and just before its bifurcation it enlarges. The *external carotid* [A. carotis externa] lies in front of the internal and runs up to the angle of the jaw, where it passes into the substance of the parotid gland. In this part of its course it is most convenient to consider the relations as antero-external and postero-internal.

The Antero-external Relations of the External Carotid Artery are—

Bones.—None, until the angle of the jaw is reached.
Muscles.—Platysma, Digastric, and Stylo-hyoid.
Arteries.—None.
Veins.—Common Facial and Lingual.
Nerves.—Hypoglossal and Ramus Descendens Hypoglossi.
Glandular and other Structures.—Nothing until the parotid gland is reached.

The muscles and fascia have already been investigated as far as this can be done at present.

The *common facial vein* [V. facialis communis] is generally formed by the union of the anterior branch of the temporo-maxillary vein joining the facial vein in the submaxillary triangle; it is, however, like all veins, liable to considerable variation.

The main vein from the tongue is generally the *ranine*, which receives the venæ comites of the lingual artery and the *dorsalis linguæ vein*, and so becomes the *lingual.* It may open separately into the internal jugular or may join the common facial.

The HYPOGLOSSAL or TWELFTH CRANIAL NERVE is a most important structure. It runs down behind the external carotid artery and between it and the internal jugular vein until the level of the great cornu of the hyoid bone is reached; here it loops round the origin of the occipital artery, and

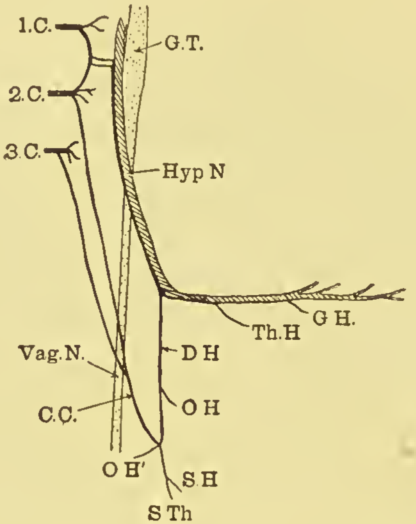


FIG. 49.—DIAGRAM OF THE HYPOGLOSSAL NERVE AND ITS CONNECTIONS.

1.*C.*, 2.*C.*, 3.*C.* Anterior Divisions of the Cervical Nerves. *G.T.* Ganglion of Trunk of Vagus. *Hyp.N.* Hypoglossal Nerve. *Vag.N.* Vagus Nerve. *C.C.* Communicans Cervicis. *O.H.* Nerve to Anterior Belly of Omo-hyoid. *O.H'.* Nerve to Posterior Belly of Omo-hyoid. *S.Th.* Nerve to Sterno-thyroid. *S.H.* Nerve to Sterno-hyoid. *D.H.* Descendens Hypoglossi. *T.H.* Nerve to Thyro-hyoid. *G.H.* Nerve to Genio-hyoid.

then runs horizontally across the neck just above and parallel to the great cornu of the hyoid bone (see Fig. 47, H.N.). It is easily found by following up the descendens hypoglossi nerve—its branch. Look carefully for a branch to the thyrohyoid muscle coming off the hypoglossal soon after the origin of the ramus descendens hypoglossi. The nerve enters its muscle on the superficial aspect. Like the descendens hypoglossi, this nerve originally comes from the first cervical.

As the boundaries of the three subordinate triangles into which the anterior triangle is divided have now been seen clearly, the posterior belly of the digastric and the stylo-hyoid muscles may be cut across and turned back. This will allow the external carotid artery and the hypoglossal nerve to be cleaned more thoroughly and traced as high as the parotid gland.

The deep or postero-internal relations of the external carotid will be seen better when the jaw has been divided and turned up, but they should be made out as far as possible now.

Postero-Internal Relations of the External Carotid Artery

Bones.—(1) Great Cornu of Hyoid; (2) Styloid Process.

Muscles.—(1) Stylo-glossus; (2) Stylo-pharyngeus; (3 and 4) Superior and Middle Constrictors of the Pharynx.

Fibrous Structures.—Stylo-hyoid Ligament.

Arteries.—(1) Internal Carotid; (2) Ascending Pharyngeal.

Veins.—Internal Jugular.

Nerves.—(1) Glosso-pharyngeal; (2) Pharyngeal; and (3) Superior Laryngeal branches of Vagus.

Most of these structures should be left until the jaw is reflected, but the following may be found at once:—

The *Superior Laryngeal Nerve* [N. laryngeus superior] passes deep to both carotids and divides high up in the neck into external and internal branches. The *Internal Laryngeal Branch* is easily found, as it pierces the thyro-hyoid membrane close to the posterior border of the thyro-hyoid muscle and just above its accompanying artery. The *External Laryngeal* is a very small nerve which supplies the crico-thyroid muscle. It passes deep to the insertion of the sterno-thyroid, and the upper part of the posterior edge of this muscle is a convenient place to pick up the nerve. As the muscle has already been divided, there will be no difficulty in tracing the

nerve, when found, to the crico-thyroid muscle, which lies

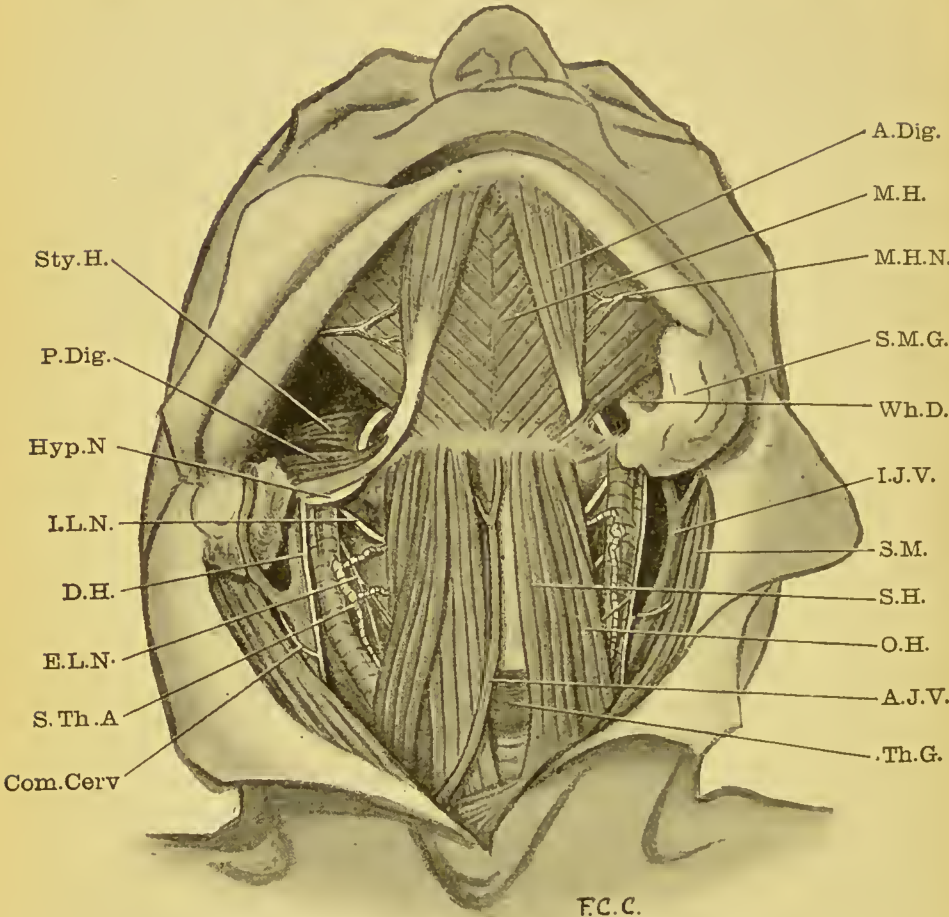


Fig. 50.—Dissection of the Neck from in Front.

A.Dig. Anterior Belly of Digastric. *M.H.* Mylo-hyoid. *M.H.N.* Nerve to Mylo-hyoid. *S.M.G.* Submaxillary Gland. *Wh.D.* Its Duct. *I.J.V.* Internal Jugular Vein. *S.M.* Sterno-mastoid. *S.H.* Sterno-hyoid. *O.H.* Omo-hyoid. *A.J.V.* Anterior Jugular Vein. *Th.G.* Isthmus of Thyroid. *Com.Cerv.* Communicans Cervicis. *S.Th.A.* Superior Thyroid Artery. *E.L.N.* External Laryngeal Nerve. *D.H.* Descendens Hypoglossi Nerve. *I.L.N.* Internal Laryngeal Nerve. *Hyp.N.* Hypoglossal Nerve. *P.Dig.* Posterior Belly of Digastric. *Sty.H.* Stylo-hyoid.

superficial to the lateral part of the crico-thyroid space.

The nerve is always very close and just deep to the course of the superior thyroid artery (see below) (see Fig. 50, E.L.N.).

The BRANCHES OF THE EXTERNAL CAROTID ARTERY should now be looked for and traced as far as the dissection will allow. There are three branches running forwards—the superior thyroid, lingual, and facial; two backwards—the occipital and posterior auricular; one upwards and inwards, the ascending pharyngeal; and, lastly, the two terminal branches—the superficial temporal and internal maxillary.

The SUPERIOR THYROID ARTERY [A. thyreoidea superior] comes off from the very beginning of the external carotid and runs downwards and forwards to the thyroid gland, where its terminal branches have already been seen (Fig. 47). In its course it gives off (1) the *superior laryngeal*, which accompanies the internal laryngeal nerve through the thyro-hyoid membrane to the interior of the larynx; (2) the occasional *sterno-mastoid branch*, which crosses the common carotid artery; (3) the *crico-thyroid*, which may, however, be a branch of the superior laryngeal; (4) *terminal glandular branches* already noticed (see p. 96). In its course this artery runs very close to the external laryngeal nerve (Fig. 47, E.L.N.).

The LINGUAL ARTERY [A. lingualis] rises opposite the tip of the great cornu of the hyoid bone, and after making an upward loop upon the wall of the pharynx, disappears deep to the hyo-glossus muscle.

The FACIAL ARTERY [A. maxillaris externa] comes off just above the lingual, sometimes by a common trunk. At first it lies superficial to the superior constrictor, and here gives off *ascending palatine* and *tonsillar* branches, though the latter often rises from the former. At this point it is deep to the angle of the jaw and only separated from the tonsil by the superior constrictor. It then runs forwards in a tortuous way, covered by the posterior belly of the digastric and the stylo-hyoid, to embed itself in the upper surface of the sub-maxillary gland as far as a point 1 inch in front of the angle

of the jaw, where it turns up on to the face. From this point its course will be followed later. In its course in the neck it gives off the above-named *ascending palatine* and *tonsillar*

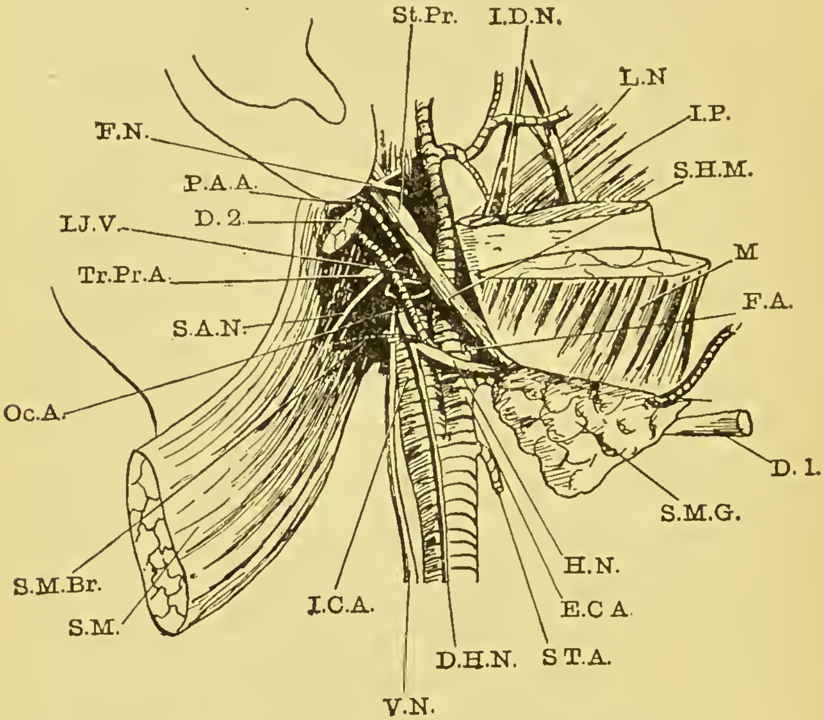


Fig. 51.—Course of the Occipital Artery.

St.Pr. Styloid Process. *I.D.N.* Inferior Dental Nerve. *L.N.* Lingual Nerve. *I.P.* Internal Pterygoid. *S.H.M.* Stylo-hyoid Muscle. *M.* Masseter. *F.A.* Facial Artery. *D.*1. Anterior Belly of Digastric. *D.*2. Posterior Belly of Digastric. *S.M.G.* Submaxillary Gland. *H.N.* Hypoglossal Nerve. *E.C.A.* External Carotid Artery. *S.T.A.* Superior Thyroid Artery. *D.H.N.* Descendens Hypoglossi Nerve. *V.N.* Vagus Nerve. *I.C.A.* Internal Carotid Artery. *S.M.* Sterno-mastoid. *S.M.Br.* Sterno-mastoid Branch of Occipital Artery. *Oc.A.* Occipital Artery. *S.A.N.* Spinal Accessory Nerve. *Tr.Pr.A.* Transverse Process of Atlas. *I.J.V.* Internal Jugular Vein. *P.A.A.* Posterior Auricular Artery. *F.N.* Facial Nerve.

branches to the pharynx, *submaxillary branches* to the gland, and a *submental branch* which should be looked for just as the artery is turning up on to the face. This last

branch runs forwards to the chin region accompanying and lying superficial to the mylo-hyoid nerve (see Fig. 42, M.H.).

The OCCIPITAL ARTERY [A. occipitalis] rises opposite the facial and runs backwards and upwards, crossing superficial to the hypoglossal nerve, which loops round its lower border, and also superficial to the internal jugular vein, vagus, and spinal accessory nerves. It runs backwards and upwards along the lower border of the posterior belly of the digastric, and ultimately disappears under cover of it (see Fig. 51).

The posterior auricular and ascending pharyngeal branches of the external carotid can hardly be satisfactorily examined at present.

The neck should now be left until the face and pterygoid regions have been dissected. It should be wrapped up with great care to prevent its drying up. First a layer of cotton wool or tow soaked in a mixture of $\frac{2}{3}$ spirit and $\frac{1}{3}$ glycerine and water should be placed over the whole of the neck. This should be covered with an oiled cloth or with gutta-percha tissue and firmly bandaged.

THE FACE

SUPERFICIAL LANDMARKS

The outline of the orbital and nasal apertures should be traced on the living face, the malar bone and zygomatic arch localised, and the condyle of the jaw felt for by slowly opening the mouth, when its movement is very evident. The infraorbital foramen can usually be made out a quarter of an inch below the infraorbital margin. It lies in a line which passes down from the supraorbital notch to the second bicuspid tooth, and this line, if prolonged down, very nearly passes through the mental foramen.

The mental foramen lies just internal to the vertical line described, and is about midway between the alveolar margin

and lower margin of the jaw, though in old and edentulous people it is, of course, higher.

The relation of the more important soft parts to the surface will be noticed as they are dealt with.

Dissection

Make a large skin flap of the whole of the side of the face, as one large flap makes such a much better covering than several small ones and does not shrink so much. To do this make an incision through the skin from just in front of the ear down to the angle of the jaw, and, if it has not been done already, forwards along the lower border of the jaw to the mid line of the chin. Now the whole of the skin of the face can be dissected forwards, with the triangular flap already turned down from the scalp as far as the mid line of the face. In doing this it will be noticed how thin the skin is in the eyelids and how thick round the mouth and side of the nose.

While the skin is being removed from the eyelids, the superficial anatomy of these structures should be noticed, not only in the dead but in a living person's eye.

With every movement of the orbicularis palpebrarum muscle the skin is thrown into minute wrinkles, since it is very closely bound to the muscle. Where the two eyelids meet internally is the *inner canthus* [commissura palpebrarum medialis], and here is a little bay, known as the *lacus lacrimalis*, containing a small pink cushion, the *caruncula lacrimalis*, formed of modified skin.

Just external to this is a small crescentic fold of the conjunctiva, a membrane described later, which is known as the *Plica Semilunaris* [P. lacrimalis], and is the vestige of the third eyelid of birds and some mammals.

On everting the margins of the eyelids a minute pinhole aperture, situated on a little papilla, will be seen in each lid just at the point at which the bay-like lacus lacrimalis joins the rest of the lid. These are the *Puncta Lacrimalia*, and

are the openings through which the tears are drained away into the canaliculi.

The amount of subcutaneous fat varies considerably, and when there is much of it the dissection of the face requires great care. It is advisable to pick up the more superficial

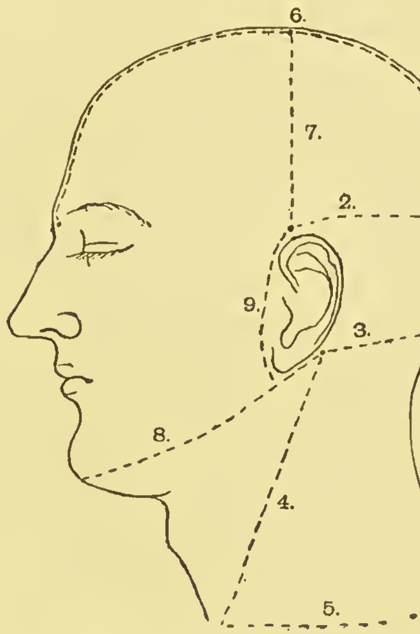


FIG. 52.—SKIN INCISIONS FOR THE DISSECTION OF THE HEAD AND NECK.

nerves, where they are largest, as early as possible lest they be cut away in searching for other things.

First look for some small twigs of the *great auricular nerve* supplying the cheek in front of the ear. They may be traced up easily from where the nerve was exposed in the neck. Some of them enter the parotid gland and become bound up with branches of the facial nerve, after which they come out again from the gland and go to the skin.

The search for this nerve will bring the dissector to the surface of the *parotid gland,* which lies between the lower jaw and the ear, and also overlaps the jaw, extending for

FIG. 53.—DISSECTION OF THE FACE.

Fr. Frontalis. *S.O.N.* Supraorbital Nerve. *S.T.N.* Supratrochlear Nerve. *Fr.A.* Frontal Artery. *O.P.M.* Orbicularis Palpebrarum Muscle. *P.N.M.* Pyramidalis Nasi Muscle. *C.N.M.* Compressor Naris Muscle. *L.L.S.A.N.M.* Levator Labii Superioris Alæque Nasi Muscle. *D.N.M.* Depressor Naris Muscles and Lateral Nasal Artery. *L.L.S.P.M.* Levator Labii Superioris Proprius Muscle. *D.F.V.* Deep Facial Vein. *Z.Ma.M.* Zygomaticus Major Muscle. *Z.Mi.M.* Zygomaticus Minor Muscle. *St.D.* Stensen's Duct. *B.5.N.* Buccal Branch of the 5th Nerve. *Ri.M.* Risorius Muscle. *O.O.M.* Orbicularis Oris Muscle. *B.M.* Buccinator Muscle. *D.A.O.M.* Depressor Anguli Oris Muscle. *D.L.I.M.* Depressor Labii Inferioris Muscle. *I.L.A.* Inferior Labial Artery. *F.A.* Facial Artery. *F.V.* Facial Vein. *Pl.* Platysma. *M.M.* Masseter Muscle. *M.7.N.* Mandibular Branch of the Facial Nerve. *P.G.* Parotid Gland. *G.A.N.* Great Auricular Nerve. *B.7.N.* Buccal Branch of the Facial Nerve. *I.O.7.N.* Infraorbital Branch of the Facial

Nerve. *Ma.7.N.* Malar Branch of the Facial Nerve. *T.7.N.* Temporal Branch of the Facial Nerve. *S.T.A.* Superficial Temporal Artery. *A.T.N.* Auriculo-temporal Nerve. *S.P.* Socia parotidis.

some distance forward on to the side of the face, upward to the zygoma and downward as far as the angle of the jaw. The gland is covered by a layer of cellular tissue continuous with the deep fascia of the neck. Now clean the surface of the gland very carefully, especially as its anterior limits are reached, and look for Stensen's duct and branches of the facial nerve coming out of it (see Fig. 53).

The Facial or Seventh Cranial Nerve emerges in six sets of branches; the upper three form the *temporo-facial division,* and are named from above downwards *temporal, malar,* and *infraorbital.* The lower three form the *cervico-facial* division, and are the *buccal, mandibular,* and *cervical.*

The *temporal twigs* [rami temporales] have already been found on the scalp, and should be traced back to the gland. The *malar* branches [rami zygomatici superiores] should be looked for in a line drawn from the lower part of the auditory meatus to the outer angle of the eye. They are small, and supply the outer fibres of the orbicularis palpebrarum muscle.

The *infraorbital branches* [rami zygomatici inferiores] are usually two, and are much larger than the last; they run forwards to the muscles lying between the eye and the mouth, and form quite a plexus with the infraorbital branch of the fifth, though this should be looked for later, as it is deep to certain of the muscles.

In cleaning these nerves *Stensen's duct* [d. parotideus] will be sure to come into view; it is the duct of the parotid, and is larger than any of the nerves; it runs forward in a line drawn from the lower part of the auditory meatus to midway between the nose and the angle of the mouth, and lies about half an inch below the zygoma. Only about the middle third of this line corresponds to the duct, because, posteriorly, it is embedded in the gland, while at the junction of the middle and anterior thirds of the line it turns sharply inwards and pierces the buccinator muscle to open into the

mouth. Keep it and study its termination after the buccinator is dissected (p. 119). Just above it there is usually a small separate lobe of the parotid, known as the *Socia Parotidis* [Gl. parotis accessoria]. Running parallel to and above the duct is the *Transverse facial artery*, a branch of the superficial temporal.

The *buccal branches of the facial nerve* [rami buccales] are found in a line running from the lower part of the auditory meatus to the angle of the mouth; they supply the buccinator and the orbicularis oris, and freely communicate with the *Long Buccal Nerve* from the third division of the fifth on the surface of the buccinator muscle. In order to expose these nerves fully it will probably be found that a thin layer of muscle running directly backwards from the angle of the mouth, and known as the *Risorius*, must be reflected. This is the uppermost part of the platysma, and in reflecting it care must be taken not to injure the facial vein which lies on its deep surface.

The *long buccal nerve* [N. buccinatorius] may now be found deeply placed on the surface of the buccinator and running downwards and forwards from under cover of the ramus of the jaw and masseter, half-way down its anterior border. It supplies the skin superficial to and the mucous membrane deep to the buccinator (B.5.N., Fig. 52).

The *mandibular branch of the facial nerve* [ramus marginalis mandibulæ] runs from the parotid gland forwards, along the surface of the lower jaw, to supply the muscles of the chin and to join twigs of the *mental branch of the fifth* [N. mentalis].

The *cervical branch of the facial nerve* [ramus colli] may just be seen passing down into the neck close to the angle of the jaw. It has already been seen in the neck.

The Muscles of Expression, to which the branches of the facial nerve pass, should next be made out.

The *Orbicularis Palpebrarum* [M. orbicularis oculi] consists of an orbital and a palpebral portion, the former

covering a good deal of the forehead and cheek. Its fibres are usually described as forming concentric rings from the internal orbital process of the frontal bone to the nasal process of the maxilla, but in a favourable subject a good dissector will notice that the continuity of the fibres in the rings is more apparent than real, and it is probable that there are upper, outer, and lower sets of fibres which closely interlace where they meet. The outer fibres are wholly attached to the skin, and make the characteristic "crow's feet" wrinkles when they contract. The palpebral or lid fibres are very pale, and run from the internal to the external tarsal ligament in both lids. Very carefully dissect the muscle away, and in doing so notice that it is blended with the frontalis and corrugator supercilii muscles. In the *Eyelids* some loose areolar tissue lies deep to the orbicularis, and this offers very little resistance to dropsical or other effusions, so that the lower eyelid is one of the first places in which dropsy shows itself.

On removing the palpebral portion of the orbicularis palpebrarum and the subjacent cellular tissue, a *Tarsal Plate* [tarsus superior et inferior] of firm fibrous tissue is seen forming a stiffening to each eyelid. Each is crescentic in form, with the concavity of the crescent turned towards the free margin of the lid. The convexity of each is attached to the orbital margin by the *Palpebral Fascia*, and, where the horns of the two crescents meet, the internal and external *Tarsal Ligaments* are found binding these to the sides of the orbit, and also representing the lines of union of the palpebral fasciæ. It will thus be seen that the tarsal plates, palpebral fascia, and tarsal ligaments are merely differentiated parts of one fibrous sheet. The internal tarsal ligament is stronger than the outer, and is also known as the *tendo oculi*; just behind it lies the *Lacrimal sac*. Now make a vertical cut right through the upper eyelid, and notice how the levator palpebræ superioris tendon, coming forwards from inside the orbit, blends with the palpebral

fascia and tarsal plate, and how, behind these, the conjunctival membrane is reflected off the back of the eyelid, which it lines, on to the eye.

This reflexion is called the *superior fornix of the conjunctiva*, and its limits should be carefully explored; a few fibres of the levator palpebræ are inserted into the fornix. On everting the cut eyelid the yellow *Meibomian glands* will

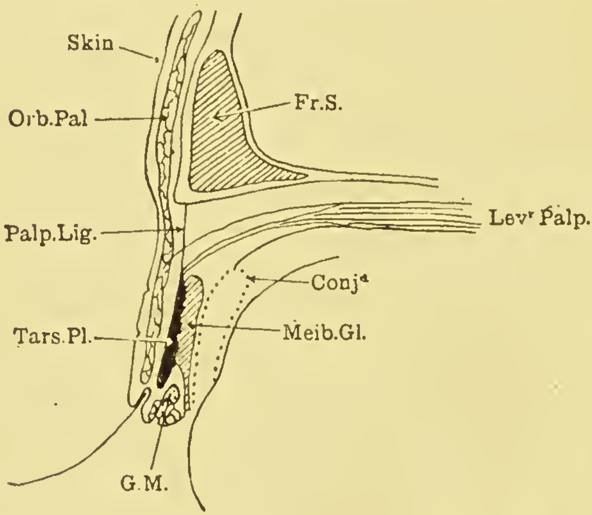


FIG. 54.—DIAGRAMMATIC SECTION OF AN EYELID.

Fr.S. Frontal Sinus. *Orb.Pal.* Orbicularis Palpebrarum Muscle. *Palp.Lig.* Superior Palpebral Fascia. *Tars.Pl.* Tarsal Plate. *G.M.* Gland of Moll. *Meib.Gl.* Meibomian Gland. *Conj*[a]. Superior Fornix of Conjunctiva. *Lev*[r]*.Palp.* Levator Palpebræ with its three insertions.

be noticed as parallel vertical streaks; they secrete a greasy sebaceous substance which prevents the eyelids sticking together, and lie embedded in the tarsal plate.

Some large sweat glands, known as *Glands of Moll*, at the free margin of the lid are noteworthy, since, when inflamed, they cause a "stye." On making a vertical section of the lower lid the same arrangement of the conjunctiva is seen, but it will be noticed that the lower tarsal plate is not so deep or thick as the upper, and that there is nothing corresponding to the levator palpebræ.

The puncta lacrimalia should now be enlarged from the deep surface of the eyelid and a fine seeker or wire pushed along the *Canaliculi* into the lacrimal sac. The upper canaliculus at first runs upwards and the lower downwards, but they very soon both turn inwards and often unite before opening into the lacrimal sac.

Slit them up in their whole length, an operation which will lead into the *Lacrimal Sac*, or upper dilated part of the nasal duct. This sac lies behind the main part of the internal tarsal ligament, but a posterior slip of the ligament passes behind it, accompanied by a few fibres of the orbicularis palpebrarum muscle, which are known as the *Tensor Tarsi* [M. tarsalis inferior].

The lacrimal sac may be opened from in front by drawing both eyelids outwards; this makes the internal tarsal ligament tense and easily felt through the skin, and a fine knife may be passed backwards and inwards close to the bone, into the sac, either just above or just below the ligament.

As soon as the region of the eyelids has been dissected, place a pad of cotton wool moistened with weak formalin, or a mixture of equal parts of glycerine spirit and water, between what is left of the lids and the eyeball to keep the front of the orbit from drying up.

Clear away the orbital part of the orbicularis palpebrarum and look for the *corrugator supercilii*, a small muscle rising from the inner part of the supraciliary eminence and running upwards and outwards to the skin of the forehead, which its fibres reach by interlacing with those of the orbicularis and frontalis. Together with the upper fibres of the orbicularis, it causes the characteristic vertical wrinkles above the root of the nose when it contracts.

Below the orbit the whole extent of the *levator labii superioris proprius* [M. quadratus labii superioris] is seen rising from just below the infraorbital margin and covering the infraorbital foramen. It passes down to the upper lip,

and in cleaning it care should be taken of the facial vein, which crosses it superficially.

The *Levator Labii Superioris et Alæ Nasi* [caput angulare musculi quadrati labii superioris] rises from the nasal process of the maxilla, close to the inner angle of the eye, and runs down to the upper lip as well as, sometimes, to the ala of the nose (see Fig. 53).

The *compressor naris* comes from the side of the bony aperture of the nose and spreads out as a fan-shaped muscle just above the ala. Along its lower margin the lateral nasal branch of the facial artery runs. To display these structures fully the levator labii superioris et alæ nasi should be cut and reflected.

Now find the entrance of the *nasal nerve* [N. nasociliaris], a branch of the first division of the fifth cranial nerve, on to the face about half-way along the lower border of the nasal bone, and follow it down to the tip of the nose. In dissecting the side of the nose two small *dilatores naris* muscles and a *depressor alæ nasi* may be seen, but they are of small importance. Next look for the *malar branch* of the *temporo-malar nerve* [N. zygomatico facialis] which comes from the second division of the fifth; its little foramen is in the malar bone about a quarter of an inch from the lower and outer angle of the orbital margin, and is covered by the orbicularis palpebrarum. The *zygomaticus major* [M. zygomaticus] rises from the posterior part of the malar bone, and the muscle should be traced down to the angle of the mouth. Its course is very superficial.

If a living face in the act of smiling is looked at, a curved crease will be noticed starting at the upper limit of the ala or distended part of the nose, and running downwards to a little distance outside the angle of the mouth. This is the *naso-labial furrow,* and is produced by the action of three facial muscles to which different parts of it are at right angles.

Starting from the nose, it runs at first nearly horizontally

outwards at right angles to the levator labii superioris proprius; then it curves downwards and outwards across the long axis of the zygomaticus major, while by the time it reaches the level of the mouth it is running directly downwards at right angles to the risorius. Different parts of this line are accentuated in displaying different emotions.

Sometimes a small *zygomaticus minor* [caput zygomaticum M. quadrati labii superioris] may be found in front of the zygomaticus major, but it is inconstant and is often merely a slip from the orbicularis palpebrarum.

Now cut the levator labii superioris very carefully, and look for the *infraorbital branch of the second division of the fifth nerve* [N. infraorbitalis] coming through the infraorbital foramen, the position of which has been localised already (see p. 107). (Fig. 55, I.O. 5th.)

The nerve gives off palpebral, nasal, and labial branches to the skin of the lower eyelid, the side of the nose, and the upper lip. Just below the infraorbital foramen is the origin of the *levator anguli oris,* which is therefore deep to the levator labii superioris proprius. The facial artery, as a rule, passes between these two muscles. (Fig. 55, L.A.O.)

The chin muscles should now be examined, though this will be found difficult, firstly, because they blend very closely with the platysma, and secondly, because the subcutaneous tissue is very dense. There is a *depressor anguli oris* [M. triangularis], which rises from the external oblique line of the lower jaw and converges to a point at the angle of the mouth, a *depressor labii inferioris* [M. quadratus labii inferioris], internal to and partly under cover of the last, and a *levator menti,* which runs down from the incisor fossa of the lower jaw, close to the mid line, and is inserted into the skin of the chin. The last muscle is best exposed by dividing the mucous membrane of the lower lip from its attachment to the gum and pulling the lip down.

While this is being done the mucous membrane may

be dissected off the deep surface of the lower lip, and then the large mass of *labial glands* will be seen separating the mucous membrane from the orbicularis oris muscle. They

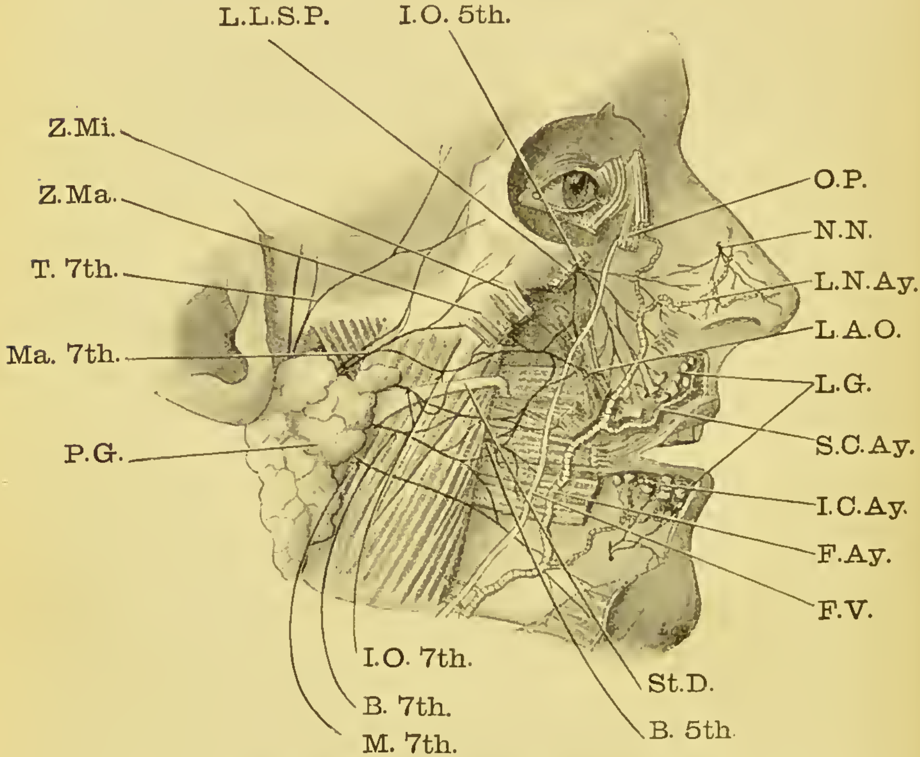


FIG. 55.—DEEP DISSECTION OF FACE.

O.P. Orbicularis Palpebrarum. *N.N.* Nasal Nerve. *L.N.Ay.* Lateral Nasal Artery. *L.A.O.* Levator Anguli Oris. *L.G.* Labial Glands. *S.C.A.* Superior Coronary Artery. *I.C.Ay.* Inferior Coronary Artery. *F.Ay.* Facial Artery. *F.V.* Facial Vein. *St.D.* Stensen's Duct. *B. 5th.* Buccal Branch of Fifth Nerve. *I.O. 7th.* Infraorbital Branch of Seventh Nerve. *B. 7th.* Buccal Branch of Seventh Nerve. *M. 7th.* Mandibular Branch of Seventh Nerve. *Ma. 7th.* Malar Branch of Seventh Nerve. *T. 7th.* Temporal Branch of Seventh Nerve. *Z.Ma.* Zygomaticus Major. *Z.Mi.* Zygomaticus Minor. *L.L.S.P.* Levator Labii Superioris Proprius.

are just as numerous in the upper lip as in the lower. (Fig. 55, L.G.)

Now find the *mental branch of the third division of the fifth nerve* [M. mentalis] coming through the mental foramen

in the same line which marked out the infraorbital nerve and about midway between the alveolar margin and the lower margin of the jaw. It supplies the skin of the lower lip and chin. To expose it cut through the depressor anguli oris muscle.

As this is the last nerve to be looked for on the face and scalp it will be well to review their arrangement. Starting from the forehead and working backwards along the side of the scalp or downwards on the face, the first, second, and third divisions of the fifth are met with in their regular order. The skin in front of and behind the ear, as well as that of a good deal of the ear itself, is supplied by the anterior primary division of the second and third cervical nerves, while behind that are the posterior primary divisions of the first three cervicals. The facial with its posterior auricular branch is entirely motor.

The *Buccinator*, though on a deeper plane than the other facial muscles, is quite evident. It rises from the alveolar margins of both upper and lower jaws, external to the molar teeth and more posteriorly from the pterygo-mandibular ligament (see Fig. 89). Anteriorly, its fibres form a large part of the orbicularis oris. Its motor nerve is derived from the facial (see p. 112), showing that it is really one of the muscles of expression and not of mastication. In cleaning the muscle a circumscribed mass of fat will be drawn out from under cover of the anterior border of the masseter. This mass is very definite in the child and is known as the "sucking-pad." The buccinator is covered by some cellular tissue known as the anterior part of the bucco-pharyngeal fascia, and embedded in this the seed-like *molar glands* are found. They are mucous glands which open into the mouth.

The *Orbicularis Oris*, which surrounds the mouth, is made up of contributions from several facial muscles as well as of some fibres which strictly belong to itself. These latter rise from the four incisor fossæ, two in the upper and two in the lower jaw (see Fig. 56, S.I. and I.I.). In

addition, a small slip is derived on each side from the anterior nasal spine (N.S.). At the angle of the mouth decussating fibres from surrounding muscles join it. Those going to the lower lip are derived from the levator anguli oris as well as some of the lower and some of the upper fibres of the buccinator (L.A.O. and B.), while to the upper

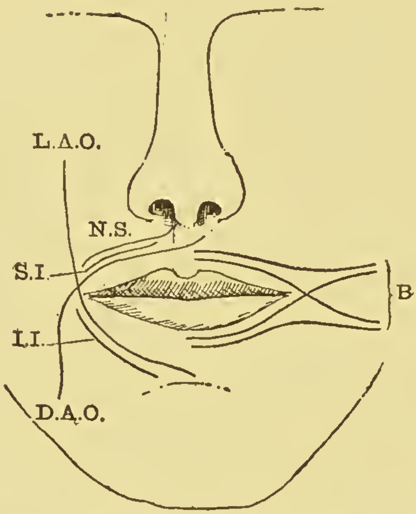


Fig. 56.—Diagram of the Components of the Orbicularis Oris Muscle.

(On the left side of the face the fibres derived from the Buccinator (*B*) are alone shown. On the right side are the other fibres.)

L.A.O. Levator Anguli Oris. *D.A.O.* Depressor Anguli Oris. *N.S.* Septal Nasal Fibres. *S.I.* Superior Incisor Slip. *I.I.* Inferior Incisor Slip.

lip go the depressor anguli oris and some of the upper and lower parts of the buccinator (D.A.O. and B.). The accompanying diagram will make this arrangement clear.

The Facial Artery and Vein [A. et V. maxillaris externa] have been met with often in the dissection, and should now be cleaned and finally examined as far as their facial course is concerned. The *vein* is the more superficial, and begins at the inner angle of the orbit, where it communicates with the frontal and other tributaries of the ophthal-

mic veins. It runs a straight course to the anterior inferior angle of the masseter, and receives tributaries corresponding to the branches of the artery, except that the inferior labial

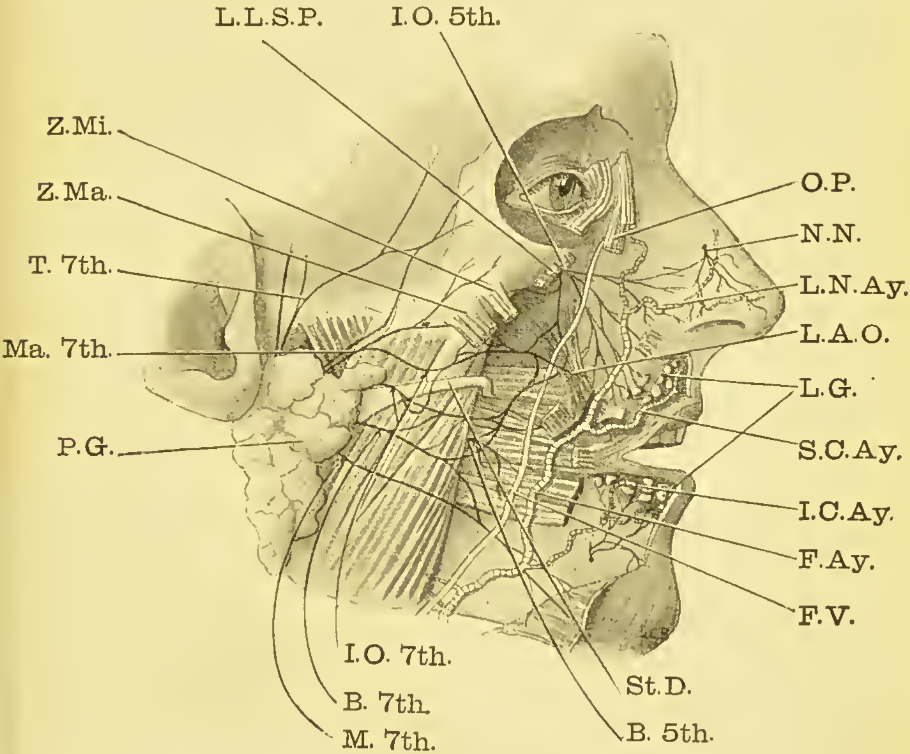


Fig. 57.—Deep Dissection of Face.

O.P. Obicularis Palpebrarum. *N.N.* Nasal Nerve. *L.N.Ay.* Lateral Nasal Artery. *L.A.O.* Levator Anguli Oris. *L.G.* Labial Glands. *S.C.A.* Superior Coronary Artery. *I.C.Ay.* Inferior Coronary Artery. *F.Ay.* Facial Artery. *F.V.* Facial Vein. *St.D.* Stensen's Duct. *B. 5th.* Buccal Branch of Fifth Nerve. *I.O. 7th.* Infraorbital Branch of Seventh Nerve. *B. 7th.* Buccal Branch of Seventh Nerve. *M. 7th.* Mandibular Branch of Seventh Nerve. *Ma. 7th.* Malar Branch of Seventh Nerve. *T. 7th.* Temporal Branch of Seventh Nerve. *Z.Ma.* Zygomaticus Major. *Z.Mi.* Zygomaticus Minor. *L.L.S.P.* Levator Labii Superioris Proprius.

and often the inferior coronary pass down the side of the chin to enter the submental vein; this is important, because the lymphatics follow the same course.

The *Facial Artery* [A. maxillaris externa] enters the

face about an inch in front of the angle of the jaw, where it is covered by the vein, and runs a tortuous course to the angle of the mouth, angle of the nose, and inner angle of the eye, which it sometimes fails to reach. It is well in front of its vein, and usually passes deep to the levator

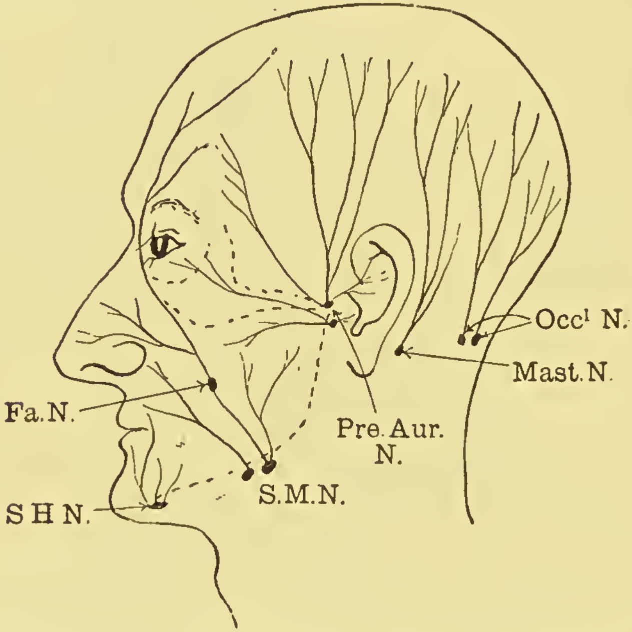


FIG. 58.—DIAGRAM OF THE COURSE OF THE LYMPHATICS IN THE HEAD AND FACE.

Fa.N. Facial (Buccal) Node. *S.H.N.* Suprahyal Node. *S.M.N.* Submaxillary Nodes. *Pre.Aur.N.* Preauricular Nodes. *Mast.N.* Mastoid Nodes. *Occ[l].N.* Occipital Nodes.

labii superioris proprius, to which the vein is superficial. Its branches are *inferior labial* to the chin, *inferior coronary*, *superior coronary*, and *lateral nasal*, while sometimes a very definite branch runs backwards to the cheek and breaks up into small arterioles, supplying the skin in this region (see Figs. 53 and 57).

The *Coronary Arteries* will be found in the red part of the lip lying deep to the orbicularis oris muscle; they are

remarkable for anastomosing very freely across the middle line as the scalp arteries do.

The face is also supplied with blood by the *transverse facial* [A. transversa faciei] branch of the superficial temporal artery, which runs forwards just above and parallel to Stensen's duct, and by the *infraorbital artery* [A. infraorbitalis], which accompanies the nerve out of the infraorbital foramen.

The FACIAL LYMPHATIC NODES are small, but because of their clinical importance should be looked for with great care. One or two *preauricular nodes* [Lymphoglandulæ parotidæ] are embedded in the top of the parotid and receive lymphatics from the side of the scalp, upper part of the face, and eyelids. *Buccal nodes* [Lymphoglandulæ faciales profundæ], on the surface of the buccinator, drain the side of the face, while occasionally an *infraorbital* and *lateral nasal node* may be found close to the facial vein in these regions, though usually the lymphatics from the front of the scalp and face accompany the facial vein down to the submaxillary nodes already noticed (see p. 87).

The lower lip and chin lymphatic vessels pass down to the suprahyoid nodes (see p. 85), while those from the upper lip may drain into the submaxillary, suprahyoid, or preauricular nodes.

It must be constantly borne in mind that lymphatic vessels here, as elsewhere, communicate freely with one another, and also, across the middle line, with those of the opposite side.

THE MOUTH

At this stage it will be well to make an examination of the interior of the mouth from in front, though everything to be seen in this way can be seen very much better by looking into two or three living persons' mouths or even by an examination of one's own mouth with a looking-glass.

Between the lips and the gums and teeth is the *vesti-*

bule, a spaee which, as long as the teeth are clenched, only communicates with the mouth behind the last molars. *Stensen's duct* opens into the vestibule opposite the second upper molar tooth on a little papilla, which may often be felt with the tip of the tongue.

The *teeth* should be looked at whenever an opportunity occurs, since they are of constant interest in medical practice. Notice how much broader the upper central incisor is than the lower; this causes it to overlap the central and half the lateral lower incisor, and from this onwards, with the exeeption of the last molar, every tooth in the upper jaw bites against two in the lower.

The *bicuspid teeth* [dentes premolares] have two cusps whieh are lingual and labial in position, while the angle of the mouth generally corresponds to the interval between these two teeth in the upper jaw. The *upper molars* have three or four cusps, the lower four or five.

The *hard palate* shows a median ridge or raphe ending in front in the little *palatine papilla,* which marks the position of the anterior palatine canal. From the raphe five or six irregular ridges, the *palatine rugœ,* run transversely outwards. At the outer and back part of the hard palate the *hamular process* may be felt with care; since it is directed backwards and outwards, it is not nearly so easily felt as might be expected on examining the dried skull. About a finger's-breadth in front of it is the opening of the *large posterior palatine canal* [Foramen palatinum majus] through which the main vessels and nerves reaeh the hard palate.

Behind the hard palate the inferior or oral surface of the *soft palate* [Velum palatinum] is seen ending posteriorly in the eonieal *uvula,* while from the sides of the soft palate run the *anterior* and *posterior pillars of the fauces* [Arci palatini], with the *tonsil* [tonsilla palatina] between them. In a healthy normal individual the tonsils hardly projeet beyond the level of the anterior pillars of the fauces.

The *dorsum of the tongue* [dorsum linguæ] occupies the greater part of the floor of the mouth, though when the

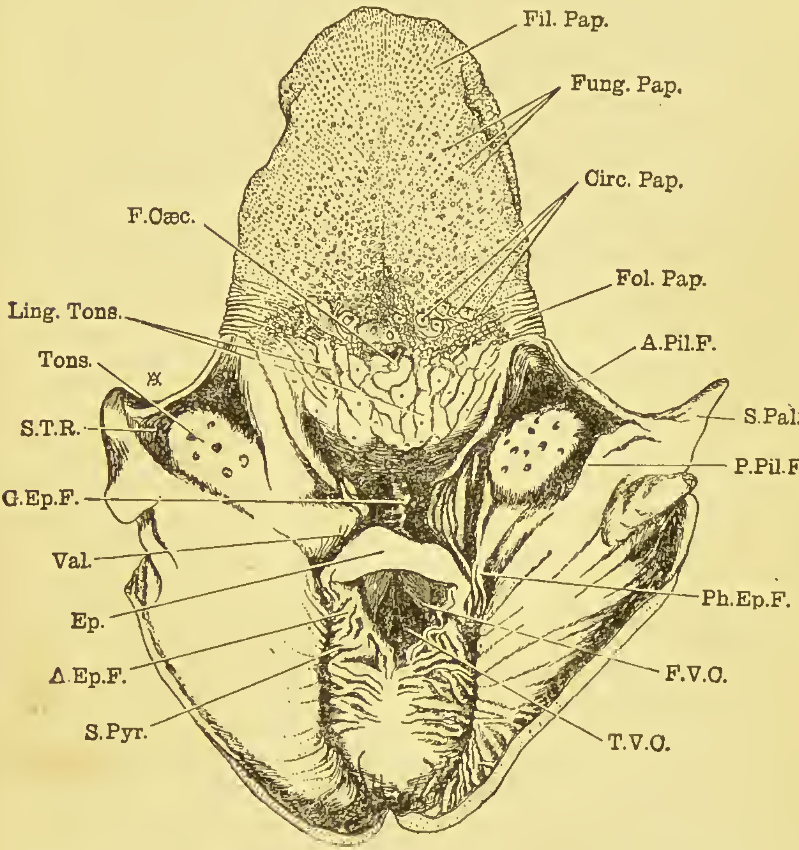


FIG. 59.—DORSUM OF TONGUE AND OPENING OF LARYNX.

Fil.Pap. Filiform Papillæ. *Fung.Pap.* Fungiform Papillæ. *Circ.Pap.* Circumvallate Papillæ. *Fol.Pap.* Foliate Papillæ. *F.Cæc.* Rod in Foramen Cæcum. *Ling.Tons.* Mucous Crypts in Lingual Tonsil. *Tons.* Tonsil. *S.T.R.* Supratonsillar Recess. *A.Pil.F.* Anterior Pillar of Fauces. *S.Pal.* Soft Palate cut and reflected. *P.Pil.F.* Posterior Pillar of Fauces. *G.Ep.F.* Glosso-epiglottic Fold. *Ph.Ep.F.* Pharyngo epiglottic Fold. *Val.* Vallecula. *Ep.* Epiglottis. *A.Ep.F.* Aryteno-epiglottic Fold. *Sr.Pyr.* Sinus Pyriformis. *F.V.C.* False Vocal Cord. *T.V.C.* True Vocal Cord.

mouth is closed it touches the hard palate in front and nearly does so behind.

The *fungiform* and *filiform papillæ* and mucous membrane generally should be carefully observed in a healthy living tongue, since the study of the dissecting-room organ is of little value to a future medical practitioner. The circumvallate papillæ cannot be studied from the front of the mouth.

On turning up the living tongue the *frenulum linguæ* is obvious in the mid line, coming from a little furrow on the under surface of the organ, and on each side of it the blue outline of the ranine vein is evident through the mucous membrane. Just external to each of these is a slight fringed fold of mucous membrane, called the *plica fimbriata*, the only practical interest of which is that it lies superficial to the course of the ranine artery.

On each side of the frenulum, near its lower attachment, *Wharton's papillæ* are easily seen; here the submaxillary or Wharton's ducts open. Running back from these is the *plica sublingualis* marking the upper edge of the sublingual gland with its numerous ducts (see p. 143).

Before finally leaving the dissection of the face it will be well to clear away the buccinator muscle of one side in order to trace Stensen's duct, and to notice that it runs forwards a little way between the muscle and mucous membrane before its opening is reached. A number of buccal mucous glands are embedded in the submucous tissue around its opening.

THE TEMPORAL REGION

The *temporal fossa* of the skull is that part which is bounded by the superior temporal ridge above and behind, by the malar bone in front, and by the zygoma below, and to all its margins the strong *temporal fascia* is attached.

The best way to appreciate this fascia is to make a vertical cut through it above the middle of the zygoma. Now, if the cut edge of the fascia be looked at, it will be seen to split

about an inch below its upper attachment into a superficial and deep layer, and these two layers may be followed down to the inner and outer surfaces of the zygoma. In front of the

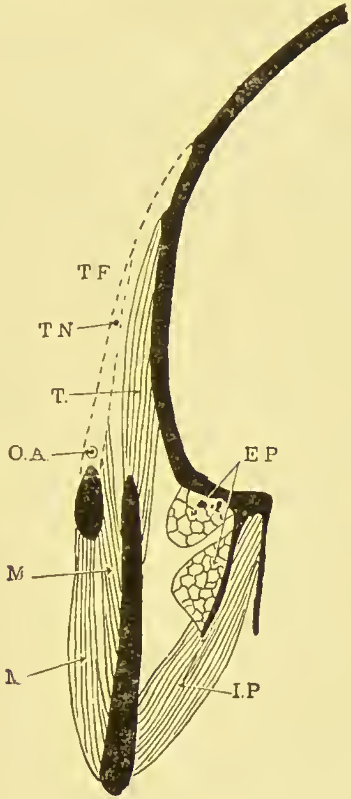


FIG. 60.—DIAGRAMMATIC CORONAL SECTION THROUGH THE LEFT SIDE OF THE SKULL AND LOWER JAW TO SHOW THE RELATIONS OF THE MASTICATORY MUSCLES.

T.F. Temporal Fascia. *T.N.* Temporal Branch of Temporo-malar Nerve. *T.* Temporal Muscle. *O.A.* Orbital Branch of Superficial Temporal Artery. *M.M.* Two Parts of Masseter. *E.P.* External Pterygoid Muscle. *I.P.* Internal Pterygoid Muscle.

cut the *temporal branch of the temporo-malar nerve* [N. zygomatico temporalis] lies between the two layers about the level of the external angular process, while just above the zygoma a little *orbital branch of the superficial temporal artery* sometimes runs forward (see Fig. 60).

Divide the lower attachments of the fascia, and turn it up to expose the greater part of the temporal muscle, but, in doing this, the *middle temporal branch* of the superficial temporal artery, which pierces the fascia just above the external auditory meatus, should be looked for and kept. Of course the various superficial structures already dissected must be turned aside, but if a sketch of them has been previously made, they can readily be replaced.

The *temporal muscle* is now exposed occupying the whole of the temporal fossa, and it will be noticed that it rises from the temporal fascia as well as from the bones forming the fossa. It is fan-shaped and tapers to its insertion, which is into the tip and anterior border of the coronoid process, by tendon, but this will be seen better when the zygoma is cut. Its anterior fibres are vertical and close the jaw, while the posterior ones are horizontal and act as retractors.

Now sketch, divide, and turn aside the structures already exposed on the *masseter muscle,* and clean its surface. Most of the fibres seen rise from the anterior two-thirds of the zygomatic arch, and run downwards and backwards to be inserted into the lower part of the outer surface of the ramus of the mandible, but at its upper and hinder angle a triangular patch of fibres, on a deeper plane than the rest, is exposed; these rise from the posterior third of the zygoma, and have a nearly vertical direction.

Divide the superficial layer of the muscle a little below the zygoma by a horizontal cut, and turn it down in order to see the whole of the deep layer. On doing so it will be noticed that the two layers are not altogether distinct. The deep layer is now seen to rise from the whole length of the zygomatic arch on its deep surface, and to be inserted chiefly into the upper part of the outer surface of the mandibular ramus.

Divide the zygoma with a Hey's saw as far forward as is possible, taking as much of the malar bone away as can be managed (see Fig. 61, Cut A). This will make the later

dissection much more easy. Another posterior cut should be made as far back as can be done without injuring the capsule of the jaw joint and the included piece of the zygoma turned down (Fig. 61, Cut B). In doing this the *masseteric nerve and artery*, coming through the sigmoid notch, must be looked for, and, when cleaned, divided. The deep part of the masseter may now be shaved off its attachment to the mandible, and the extent of its attachment noted. When these structures are removed, the whole surface of the ramus

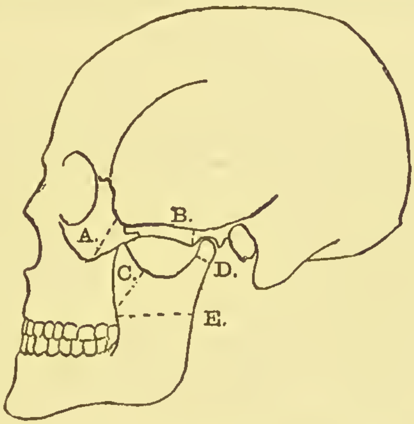


FIG. 61.—DIAGRAM OF THE BONE INCISIONS NECESSARY TO EXPOSE THE PTERYGOID REGION. THE LETTERS ARE REFERRED TO IN THE TEXT.

of the jaw, with its coronoid process and the insertion of the temporal muscle, is exposed, and the next step is to divide the coronoid process from the rest of the mandible by an oblique cut reaching from the sigmoid notch to the lower part of the anterior border of the ramus, in order to include as much as possible of the insertion of the temporal muscle (Fig. 61, Cut C). Now the temporal muscle and coronoid process may be turned up, and it will be seen that, in addition to the strong tendinous insertion into the tip and anterior border of the process, there is a more fleshy one on its deep surface. In turning up the muscle the *deep temporal arteries and nerves* must be looked for running up to

enter its deep surface in front of the root of the zygoma; they should be reflected leaving a small portion of muscle attached. When this has been done the temporal muscle can be reflected still farther, and, just above the external auditory meatus, the *middle temporal artery*, which is very constant, will be seen running upwards, supplying the back part of the muscle with blood. In turning up the front part of the muscle, the little temporal branch of the temporomalar nerve may be traced to its foramen in the malar bone. Finally, the whole temporal muscle should be shaved off the skull, and its exact origin noticed.

PTERYGOID REGION

The neck of the condyle must be carefully cut through with the Hey's saw and bone forceps, remembering that the internal maxillary artery lies deep to it (Fig. 61, Cut D). Then the ramus of the jaw should be divided horizontally above the level of the inferior dental foramen, which is situated midway between the sigmoid notch and the lower margin of the jaw; the cut should therefore be a little above this level: if the section is made too low, the inferior dental nerve will be divided (Fig. 61, Cut E). It is better to cut partly through the bone with the saw and to finish with the forceps, keeping the flat side of the blades towards the part which is to be saved. As an extra precaution the handle of a scalpel may be pushed forwards deep to the bone and the cut made on to that.

When the piece of bone is lifted out, the *inferior dental nerve* [N. alveolaris inferior] should be looked for, entering the foramen near the junction of the posterior and middle thirds of the ramus, and, if another horizontal strip of the jaw can be taken away without damaging the nerve, it should be done, as every fraction of space gained makes the later dissection easier.

Now find the insertion of the *external pterygoid muscle*

into the front of the neck of the condyle, and carefully clean the surface of the muscle, looking out for the *internal maxillary artery* and the *long buccal nerve;* the latter is easily found by following it back from the surface of the buccinator, where it has been exposed already. In addition to these structures there are numerous veins forming part of the *pterygoid plexus,* which surrounds the external pterygoid muscle, and is drained backwards by the internal maxillary vein, and forwards by the deep facial vein, which has been already found. The plexus is difficult to display, but is important because it communicates freely with most of the deep veins of the head.

Other very important structures which are often missed are two or three *internal maxillary lymphatic nodes* which lie on the surface of the external pterygoid muscle and drain the nose, pharynx, temporal and zygomatic fossæ, orbit and dura mater.

The course of the INTERNAL MAXILLARY ARTERY [A. maxillaris interna] is sometimes deep to the external pterygoid, though in rather more than half the cases it is superficial; it comes from the termination of the external carotid in the parotid gland, and is easily found deep to the neck of the condyle, especially if this be drawn out with a chain hook. As a rule, the artery runs a little upwards and then downwards along the lower border of the external pterygoid, though in both cases its direction is forward as well. About the middle of the lower border of the muscle it turns forwards and upwards once more, and passes, either superficial or deep to the external pterygoid, toward the spheno-maxillary fossa. It will usually be noticed that the two most important branches of the artery come off at or close to these two bends, the *middle meningeal* [A. meningea media] being opposite the convexity upwards, and the *inferior dental* [A. alveolaris inferior] opposite the downward one. The artery is often arbitrarily divided into three parts by the external pterygoid: the first before that muscle is reached,

the second either superficial or deep to the muscle, and the third in the spheno-maxillary fossa. From the first part rise several branches, which all pass through foramina. Of these the *middle meningeal* and *inferior dental* have

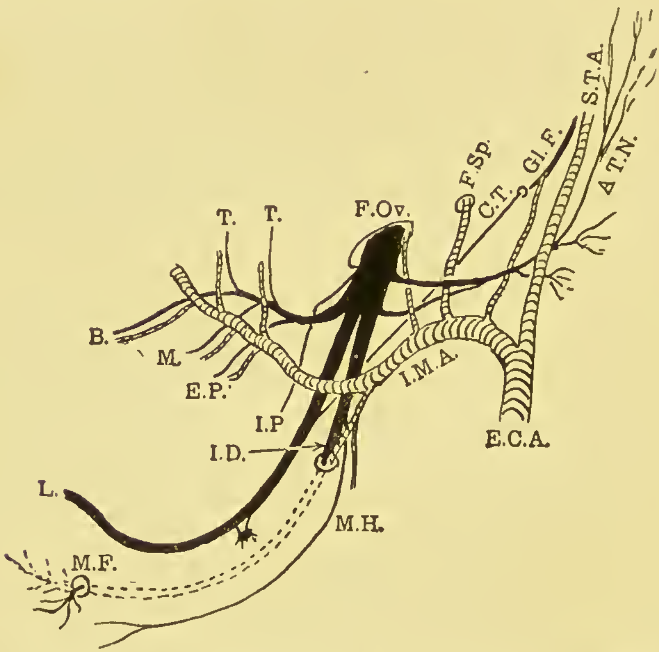


Fig. 62.—Diagram of Structures in the Left Pterygoid Region.

B. Buccal Artery and Nerve. *T.* Deep Temporal Nerves. *F.Ov.* Foramen Ovale. *F.Sp.* Foramen Spinosum with Middle Meningeal Artery. *C.T.* Chorda Tympani. *Gl.F.* Glaserian Fissure with Tympanic Artery. *S.T.A.* Superficial Temporal Artery. *A.T.N.* Auriculo-temporal Nerve. *E.C.A.* External Carotid Artery. *I.M.A.* Internal Maxillary Artery. *M.H.* Mylo-hyoid Artery and Nerve. *I.D.* Inferior Dental Nerve and Artery. *M.F.* Mental Foramen. *L.* Lingual Nerve. *I.P.* Nerve to Internal Pterygoid Muscle drawn forward. *E.P.* Nerve to External Pterygoid Muscle. *M.* Masseteric Nerve.

already been noticed, and they are the only ones of any real importance. Only the root of the former can be seen at this stage, as it passes up deep to the external pterygoid muscle. The *inferior dental artery* runs down close to the nerve of the same name, and before entering the foramen gives off the

little *mylo-hyoid branch.* In addition to these the tympanic and small meningeal branches are sometimes seen.

They may be sought close to or rising in common with the middle meningeal. Later on, when the external pterygoid muscle has been reflected, it may be possible to trace the tympanic artery to the Glaserian fissure and the small meningeal to the foramen ovale.

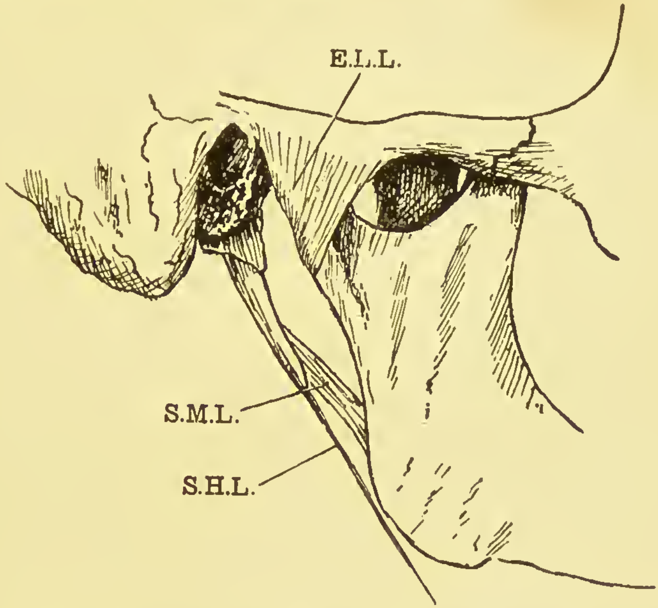


FIG. 63.—TEMPORO-MAXILLARY ARTICULATION, FROM OUTER SIDE.

E.L.L. External Lateral Ligament. *S.M.L.* Stylo-mandibular Ligament. *S.H.L.* Stylo-hyoid Ligament.

Just in front of the inferior dental nerve, and, like it, becoming visible at the lower border of the external pterygoid muscle, is the *lingual nerve.*

In order to see more of these structures the external pterygoid must be turned forward with the condyle of the jaw, and in doing this the articulation should be studied as thoroughly as possible.

TEMPORO-MAXILLARY JOINT [articulatio mandibularis].—Clean the capsule as much as possible, and define the

thickened external lateral ligament which runs downwards and backwards from the tubercle at the anterior root of the zygoma to the outer and back part of the neck of the condyle. When the condyle is retracted this is tight, but its obliquity allows the jaw to move forwards and downwards below the eminentia articularis. The anterior part of the capsule can hardly be seen, because the tendon of the external pterygoid blends with it; it is horizontal and very thin, and is attached in front of the eminentia articularis. The posterior ligament is also very thin, and is attached just in front of the Glaserian fissure (a dry skull should be at hand to verify these points). Posteriorly this ligament is in contact with the glenoid lobe of the parotid gland, when there is such a lobe, and with the auriculo-temporal nerve. Now divide the capsule as close to the skull as possible, in order to get above the *interarticular meniscus* [discus articularis] or fibro-cartilage, which keeps the condyle from actually touching the glenoid fossa. This part of the dissection requires very great care in order to avoid (1) damaging the meniscus, and (2) cutting the auriculo-temporal nerve, the latter being an accident which, in the writer's experience, happens more often than not. When the outer part of the capsule has been cut the condyle must be pulled downwards as forcibly as possible, and the inner part divided in the most careful manner with the very point of the knife. When this is done, the condyle can be drawn forward, with the meniscus and external pterygoid attached, and disengaged from the internal maxillary artery. Now separate the meniscus from the condyle and, in doing so, notice that it is attached to the capsule all round its margins, so that there is one synovial cavity above and another below it, and that these are perfectly distinct. The upper one is by far the more roomy, and allows the meniscus and condyle to glide forwards and backwards on the glenoid fossa and eminentia articularis, while the smaller, lower one is for the condyle to move like a hinge on the meniscus. In

opening the mouth, both the hinge movement below the meniscus and the forward gliding movement above it occur together. The attachments of the external pterygoid can now be verified—the upper head coming from the pterygoid ridge and the part of the great wing of the sphenoid internal to it; the lower from the outer surface of the external pterygoid plate—while the insertion is into the front of the meniscus as well as into the neck of the condyle.

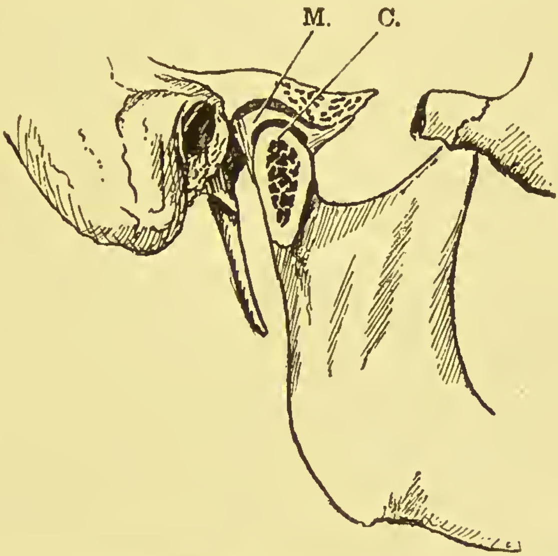


FIG. 64.—SAGITTAL SECTION OF TEMPORO-MAXILLARY ARTICULATION.
M. Meniscus. *C.* Condyle.

The fibrous tissue of the external pterygoid muscle's insertion simply blends with that of the anterior part of the capsule and of the meniscus. On reflecting the muscle the nerve supplying it from the third division of the fifth should be carefully looked for on its deep surface.

Now the lingual and inferior dental nerves may be followed up to where they diverge from the trunk of the third division of the fifth a little below the foramen ovale, and as this point is approached the beginning of the *auriculo-temporal* nerve should be looked for.

This may be found by pulling on the part of the nerve already dissected and following it along to the main trunk of the third division of the fifth from which it arises, often by two roots embracing the middle meningeal artery, though

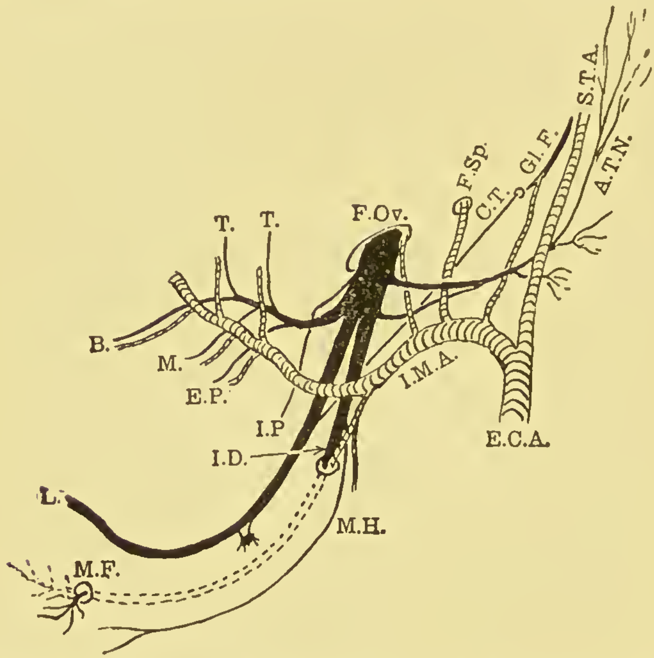


FIG. 65.—DIAGRAM OF STRUCTURES IN THE LEFT PTERYGOID REGION.

B. Buccal Artery and Nerve. *T.* Deep Temporal Nerves. *F.Ov.* Foramen Ovale. *F.Sp.* Foramen Spinosum with Middle Meningeal Artery. *C.T.* Chorda Tympani. *Gl.F.* Glaserian Fissure with Tympanic Artery. *S.T.A.* Superficial Temporal Artery. *A.T.N.* Auriculo-temporal Nerve. *E.C.A.* External Carotid Artery. *I.M.A.* Internal Maxillary Artery. *M.H.* Mylo-hyoid Artery and Nerve. *I.D.* Inferior Dental Nerve and Artery. *M.F.* Mental Foramen. *L.* Lingual Nerve. *I.P.* Nerve to Internal Pterygoid Muscle drawn forward. *E.P.* Nerve to External Pterygoid Muscle. *M.* Masseteric Nerve.

sometimes the deeper root of the two is absent. Coming off from the front of the third division of the fifth, just below the foramen ovale, is the *anterior trunk* of the mandibular division of the fifth nerve dividing into branches for the muscles of mastication.

All of these, namely, the *deep temporal, long buccal, masseteric* and the *nerve to the external pterygoid*, have been seen already, and simply need tracing back. The *long buccal nerve* passes between the two heads of the external pterygoid, and, unlike the rest, is sensory.

The ascending branches of the first part of the internal maxillary artery, the *tympanic, middle*, and *small meningeal*, should now be traced up to their respective foramina. Just behind the foramen spinosum, where the middle meningeal disappears, is the spine of the sphenoid, and from the posterior part of this the *long internal lateral ligament* of the jaw [L. spheno-mandibulare] runs downwards, widening out as it goes, to the lower margin of the inferior dental canal and to the lingula, situated just in front of this. Between it and the neck of the condyle, the first part of the internal maxillary artery and its accompanying vein run, while at its lower part the inferior dental nerve lies between it and the ramus of the jaw; the *mylo-hyoid branch* of this nerve should be looked for, and usually will be seen to pierce the lower attachment of the ligament. This so called long internal lateral ligament probably has nothing, either morphologically or physiologically, to do with the capsule of the joint.

In the antero-inferior part of the space exposed by the removal of the ramus is the *internal pterygoid muscle*, the upper or deep head of which can be seen rising from both walls of the pterygoid fossa and from the tuberosity of the palate, which fits in between the two plates. The lower or superficial head, which is quite small, comes from the tuberosities of the maxilla and palate. The fibres run downwards, backwards and outwards to the inner side of the jaw, between the angle and inferior dental foramen, though this will be better seen later when the jaw is turned up.

The upper border of the muscle should be carefully defined, because just at the point where the lingual nerve comes in contact with it, is the place to look for the junction

of that nerve with the *chorda tympani*, a branch of the facial which comes out of the skull at the iter chordæ anterius, just behind the spine of the sphenoid. The junction of the chorda tympani with the lingual nerve forms a very

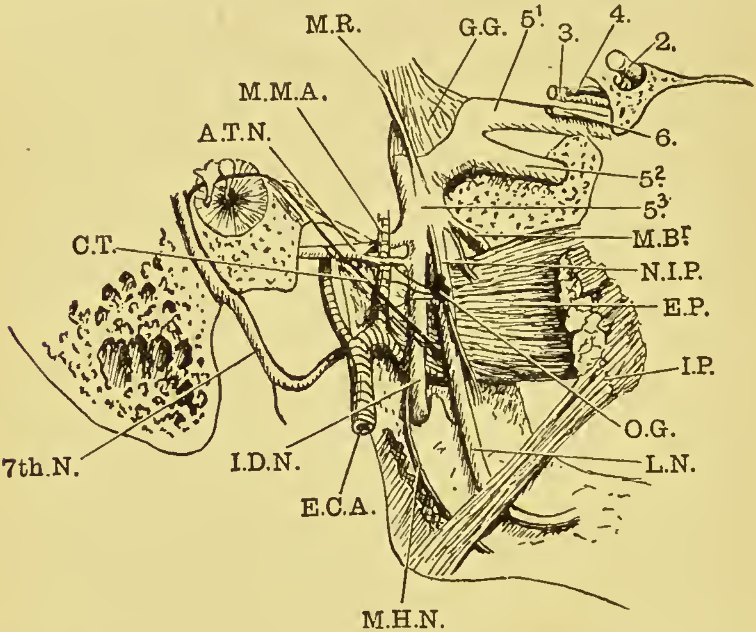


Fig. 66.—Dissection of the Left Pterygoid Region and its Surroundings from the Medial Aspect.

2, 3, 4, 5¹, 5², 5³, and 6 are the Cranial Nerves bearing those Numbers. *M.Bʳ.* Muscular Branch. *N.I.P.* Nerve to Internal Pterygoid. *E.P.* External Pterygoid Muscle. *I.P.* Internal Pterygoid Muscle. *O.G.* Otic Ganglion. *L.N.* Lingual Nerve. *M.H.N.* Mylo-hyoid Nerve. *E.C.A.* External Carotid Artery. *7th.N.* Facial Nerve. *C.T.* Chorda Tympani. *A.T.N.* Auriculo-temporal Nerve. *M.M.A.* Middle Meningeal Artery. *M.R.* Motor Root of Fifth Nerve. *G.G.* Gasserian Ganglion.

sharp angle, and it is best to catch hold of the lower part of the lingual with the forceps and carefully clean its posterior edge from fat with the point of the knife. The chorda tympani, when found, should be traced upwards and backwards, deep to the inferior dental nerve, auriculo-temporal nerve, and internal maxillary artery; indeed, it is so deep in

the space that it is hardly ever cut away, though a communicating branch which is sometimes found between the lingual and inferior dental nerves is often mistaken for it.

The *nerve to the internal pterygoid* may be looked for now as well as the otic ganglion, but they are both more easily seen and reached from the mid line later on when the skull has been bisected. From this, its outer aspect, the nerve to the internal pterygoid may be displayed by dissecting just in front of and deep to the upper part of the lingual nerve. The only difficulty about the dissection is its depth (see Fig. 66).

On looking carefully at a skull it will be easily appreciated that the Eustachian tube and levator palati muscle lie deep to the third division of the fifth nerve and its branches, as it passes down from the foramen ovale.

DEEP DISSECTION OF THE SUBMAXILLARY REGION

Having reviewed the superficial dissection of the submaxillary triangle, saw through the mandible just external to the attachment of the digastric muscle, and after dividing the facial artery and vein, turn the piece of bone up. Next cut through the anterior belly of the digastric close to its tendon, and turn it forwards very gently so as to see its nerve from the mylo-hyoid branch of the inferior dental. The whole course of this mylo-hyoid nerve can now be traced up to the inferior dental foramen, where it comes off.

This allows the *submaxillary gland* to be studied, and it will be noticed on turning it up that it is astride of the posterior border of the mylo-hyoid muscle; its superficial lobe passing forwards on the exposed surface of the mylo-hyoid, while its deep lobe is concealed by the muscle. Sometimes, as in Fig. 67, the deep lobe of the submaxillary gland is prolonged forwards below the duct for a great distance.

The *mylo-hyoid* is now in full view, rising from the mylo-hyoid ridge of the lower jaw, and being inserted partly into a median raphe, which runs from the chin to the hyoid bone and partly into the lower part of the anterior surface of the

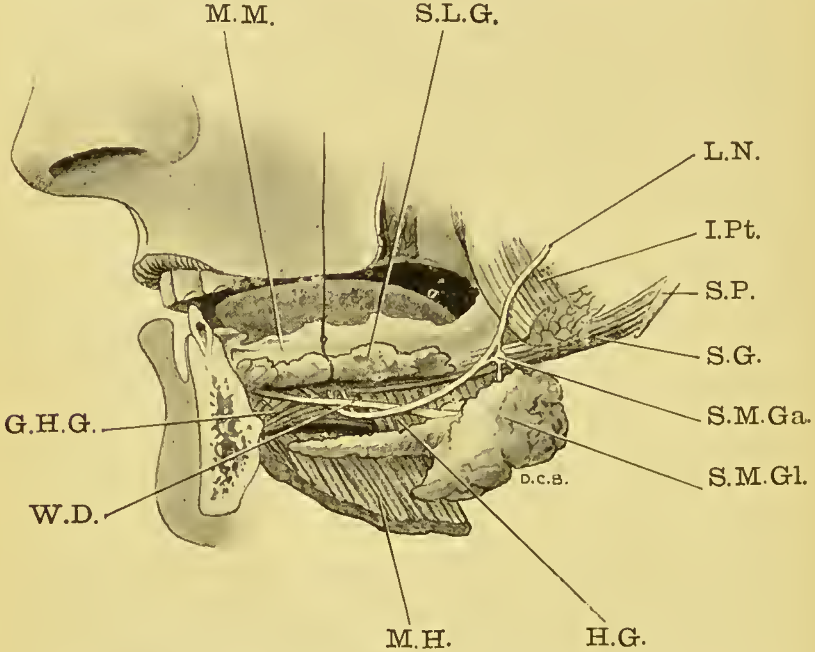


FIG. 67.—THE SUBMAXILLARY GLAND AND ITS DUCT.

M.M. Mucous Membrane of the Mouth. *S.L.G.* Sublingual Gland turned up. *L.N.* Lingual Nerve. *I.Pt.* Internal Pterygoid. *S.P.* Styloid Process. *S.G.* Stylo-glossus Muscle. *S.M.Ga.* Submaxillary Ganglion. *S.M.Gl.* Submaxillary Gland. *H.G.* Hyo-glossus Muscle. *M.H.* Mylo-hyoid Muscle. *W.D.* Wharton's Duct with Lingual Nerve looping under it. *G.H.G.* Genio-hyo-glossus Muscle.

body of the hyoid. Note that the branches of the mylo-hyoid nerve enter the superficial aspect of the muscle. Now divide the mylo-hyoid muscle close to its attachment to the lower jaw and turn it down.

The deep part of the submaxillary gland is now exposed, and its duct (Wharton's duct) [D. submaxillaris] must be carefully looked for, running forwards and upwards until it

passes deep to the lingual nerve, which will be seen running downwards and forwards from the superficial surface of the internal pterygoid muscle (see Fig. 67).

By detaching the insertion of this muscle from the inner surface of the mandible, between the inferior dental foramen and the angle, the whole course of the lingual nerve from the foramen ovale to the submaxillary region will be displayed.

Notice that it lies between the jaw and the mucous membrane of the mouth. If a finger is pressed back between the tongue and the mandible, about an inch below and behind the last molar tooth, in a living person, the nerve will be reached and the pressure readily felt. Here it may be divided from inside the mouth to relieve pain in cancer of the tongue.

In the angle which the duct and the lingual nerve make just before they cross one another, the *submaxillary ganglion* lies; it hangs from the lingual by two roots, and is generally quite easy to find. Nerves from it may easily be traced into the submaxillary gland.

The *Hypoglossal Nerve* may be cleaned as it runs forwards a little way above the great cornu of the hyoid bone, and a well-marked branch running downwards and forwards to the genio-hyoid muscle as well as another running upwards and backwards to the stylo-glossus muscle looked for.

Running parallel and quite close to the hypoglossal nerve, the *ranine vein* [V. comitans, N. hypoglossi] is often seen; it may be double, but is often absent altogether. The whole surface of the hyo-glossus muscle is now exposed, rising from the outer border of the great cornu of the hyoid bone and also slightly from the body, where it dovetails into the insertion of the genio-hyoid. Its fibres run upwards and forwards to the tongue, and its relations, which are very important, should be reviewed.

The superficial relations of the hyo-glossus are (see Fig. 68)—

1. *Bones.*—The lower Jaw at some little distance.

2. *Muscles.*—The Internal Pterygoid, Mylo-hyoid, posterior belly of the Digastric and Stylo-hyoid, Stylo-glossus.

3. *Fibrous Structures.*—Cervical cellular tissue.

4. *Arteries.*—Facial, embedded in the submaxillary gland.

5. *Veins.*—Ranine and quite superficially the Facial.

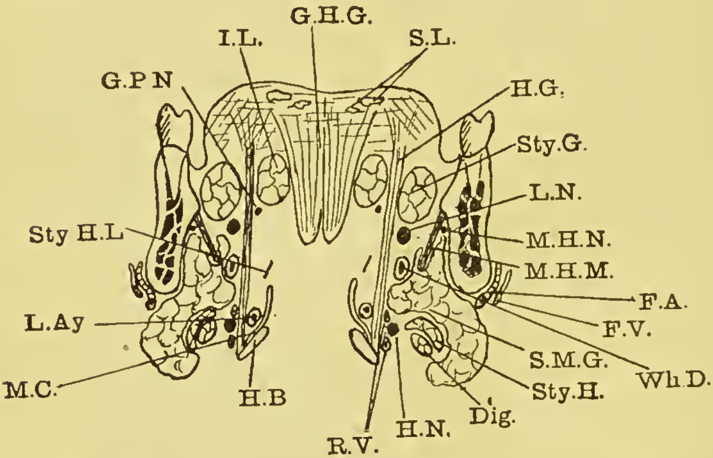


Fig. 68.—Coronal Section through the Back of the Tongue to show the Relations of the Hyo-glossus Muscle.

G.H.G. Genio-hyo-glossus. *S.L.* Superficial Lingualis. *H.G.* Hyo-glossus. *Sty.G.* Stylo-glossus. *L.N.* Lingual Nerve. *M.H.N.* Mylo-hyoid Nerve. *M.H.M.* Mylo-hyoid Muscle. *F.A.* Facial Artery. *F.V.* Facial Vein. *Wh.D.* Wharton's Duct. *S.M.G.* Submaxillary Gland. *Sty.H.* Stylo-hyoid. *Dig.* Digastric. *H.N.* Hypoglossal Nerve. *R.V.* Ranine Veins. *H.B.* Hyoid Bone. *M.C.* Middle Constrictor. *L.Ay.* Lingual Artery. *Sty.H.L.* Stylo-hyoid Ligament. *G.P.N.* Glosso-pharyngeal Nerve. *I.L.* Inferior Lingualis.

6. *Nerves.*—Lingual, Submaxillary ganglion, and Hypoglossal.

7. *Glandular and other Structures.*—The submaxillary gland and its duct.

As the lingual nerve reaches the front of the hyo-glossus muscle it forms a loop under Wharton's duct, and then runs upwards and forwards deep to it, but its further course is at present hidden by the *sublingual gland*, an almond-shaped structure lying just in front of the hyo-glossus muscle.

The relations of this gland are easily made out, and can be followed on oneself by a finger in the mouth. Externally would be the body of the mandible, which is now upturned. Internally (deep) are the genio-hyo-glossus muscle, the lingual nerve, and Wharton's duct. These may be seen by turning the gland up. Above is the mucous membrane

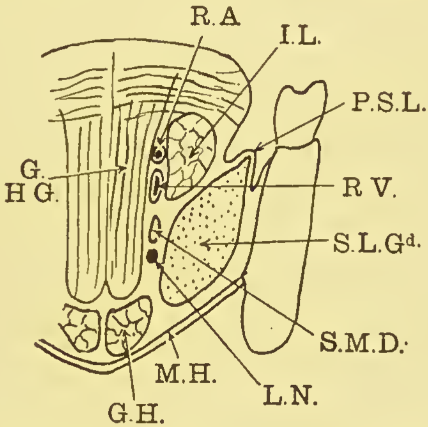


FIG. 69.—DIAGRAMMATIC TRANSVERSE SECTION OF TONGUE TO SHOW THE RELATIONS OF THE SUBLINGUAL GLAND.

R.A. Ranine Artery. *I.L.* Inferior Lingualis Muscle. *P.S.L.* Plica Sublingualis. *R.V.* Ranine Vein. *S.L.G^d.* Sublingual Gland. *S.M.D.* Submaxillary (Wharton's) Duct. *L.N.* Lingual Nerve. *M.H.* Mylo-hyoid Muscle. *G.H.* Genio-hyoid Muscle. *G.H.G.* Genio-hyo-glossus Muscle.

of the floor of the mouth, while below is the cut mylo-hyoid muscle (see Fig. 69).

The upper edge of the almond-shaped gland pushes up the mucous membrane of the mouth into a ridge known as the *plica sublingualis*, and here its numerous ducts (sometimes called ducts of Rivinus) [D.d. sublinguales minores] open.

When the gland is turned up the lingual nerve will be seen to give numerous twigs to it as well as to the mucous membrane of the tongue, as far as its tip.

Wharton's duct, which is thin-walled and easily torn, may

be traced forward to near the mid line, where it opens into the floor of the mouth on the papilla already noticed (see p. 126).

Clean the surface of the genio-hyo-glossus muscle in front of the hyo-glossus, and notice the hypoglossal nerve breaking up to supply the various muscles of the tongue.

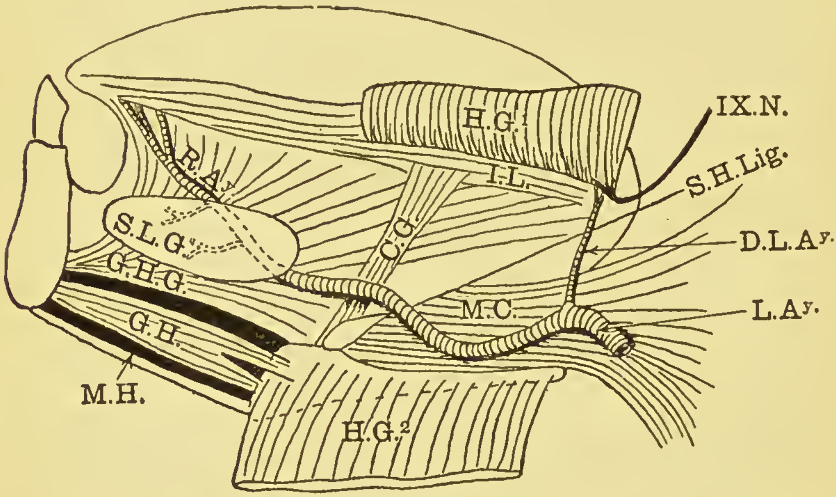


Fig. 70.—Deep Dissection of the Side of the Tongue.

H.G[1]. *H.G*[2]. Hyo-glossus Muscle reflected. *I.L.* Inferior Lingualis. *IX.N.* Glosso-pharyngeal Nerve. *S.H.Lig.* Stylo-hyoid Ligament. *D.L.A*y. Dorsalis Linguæ Artery. *L.A*y. Lingual Artery. *M.H.* Mylo-hyoid Muscle. *G.H.* Genio-hyoid. *G.H.G.* Genio-hyo-glossus. *S.L.G.* Sublingual Gland. R.Ay. Ranine Artery. *C.G.* Chondro-glossus Muscle.

Define the anterior and posterior borders of the hyo-glossus, and then cut that muscle through horizontally and reflect it up and down. Its deep relations will now be seen. They are:—

Bones.—The lesser cornu of the Hyoid.

Muscles.—Middle Constrictor of the Pharynx, Genio-hyo-glossus and Inferior Lingualis.

Fibrous Structures.—Stylo-hyoid ligament.

Arteries.—Lingual and its dorsalis linguæ branch.

Veins.—Venæ comites of these arteries.

Nerves.—Glosso-pharyngeal.

The *lesser cornu of the hyoid* is very easily defined, deep to the anterior border of the hyo-glossus; it is usually joined to the rest of the hyoid bone by fibrous tissue only, bony union being rare even in old people.

The *stylo-hyoid ligament* runs from the tip of the lesser cornu to the tip of the styloid process, and is generally best marked in the lower part of its course.

The *middle constrictor of the pharynx* [M. constrictor pharyngis medius] is easily seen rising from the lower part of the stylo-hyoid ligament, from the lesser cornu of the hyoid, and from the outer edge of the great cornu as far as its tip; there is often a gap between the parts coming from the lesser and greater cornua.

The *genio-hyo-glossus muscle* [M. genio-glossus] has been partly exposed already in lifting up the sublingual gland. Finish cleaning its surface, and notice that it rises from the upper genial tubercle near the mid line of the mandible. Its upper fibres are lost in the front of the tongue, but those which are lower run back deep to the hyo-glossus, and a few may even reach the top of the body of the hyoid bone, though their attachment here is of the slightest.

A few vertical fibres will probably be made out as a little bundle running up from the lesser cornu of the hyoid, and partly concealing the hinder end of the genio-hyo-glossus; these form the little *chondro-glossus,* and are always to be seen if looked for (see Fig. 70).

Twigs from the hypoglossal nerve are easily traced into the genio-hyo-glossus.

The *lingual artery* runs a wavy course forwards, deep to the hyo-glossus, lying just above the great cornu of the hyoid bone and just below the line of the hypoglossal nerve. Here the middle constrictor is deep to it. When it reaches the anterior border of the hyo-glossus, it runs upwards and forwards, deep to the hypoglossal nerve and Wharton's duct,

to sink gradually into the substance of the genio-hyo-glossus.

Its *dorsalis linguæ* branch comes off deep to the posterior part of the hyo-glossus, while *sublingual branches* are given to that gland in front of the muscle.

The terminal part of the lingual is often spoken of as the *ranine artery.*

The *Glosso-pharyngeal Nerve* needs some little care to find. First localise the styloid process and clean its posterior border; this will expose the origin of the stylo-pharyngeus muscle, and winding round the posterior border of this muscle the nerve will be found.

Notice that it is only about half the size of the hypoglossal or lingual nerves.

On reaching the posterior part of the hyo-glossus it passes deep to the dorsalis linguæ artery, and here there is usually quite a plexus of veins coming from the tonsil, which lies deeper still at this spot. Among the veins, twigs [rami tonsillares] are seen running from the glosso-pharyngeal to form a nerve plexus for the tonsil and its neighbourhood. This is known as the *circulus tonsillaris,* but the nerves forming it are very small. The termination of the glosso-pharyngeal nerve may be traced through the substance of the genio-hyo-glossus to the back and sides of the tongue, dividing into numerous branches remarkable for their tortuosity.

DISSECTION OF THE PAROTID GLAND [Gl. Parotis]

The superficial aspect of the gland has been noticed in the dissection of the face. The auriculo-temporal nerve and superficial temporal vessels have been traced to its upper border; the facial nerve, Stensen's duct, and transverse facial artery to its anterior border.

Below, the anterior and posterior divisions of the temporo-maxillary vein, and the great auricular nerve, have been seen

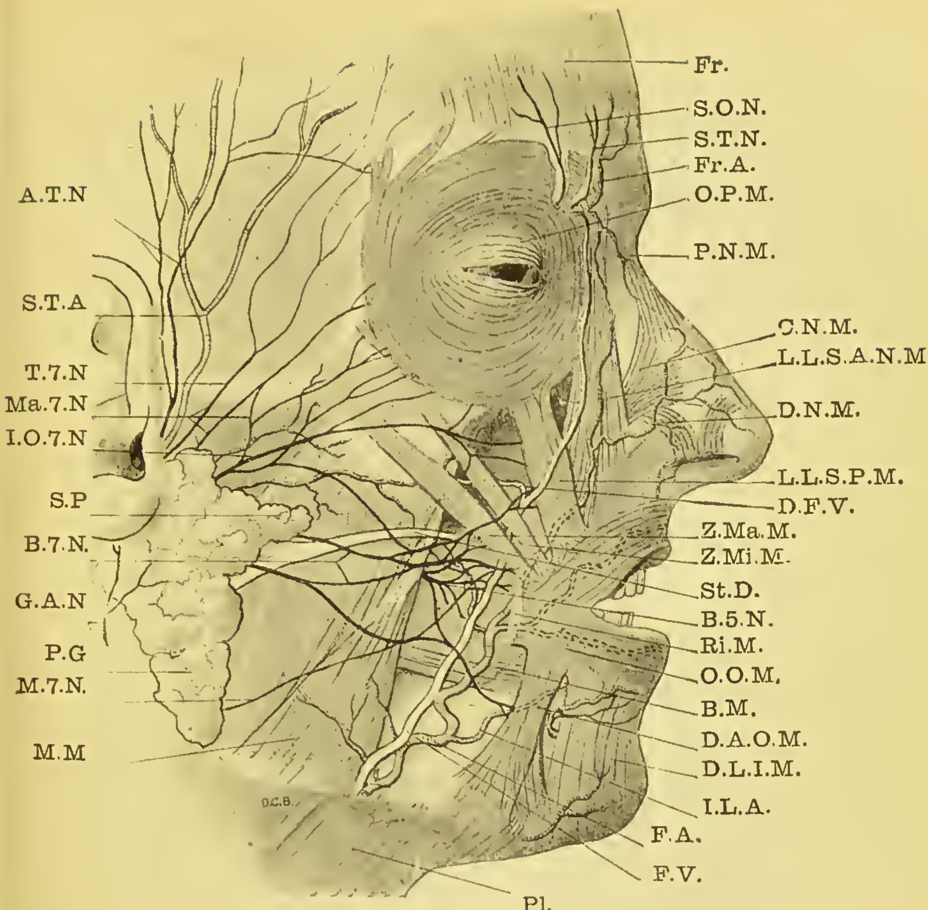


FIG. 71.—DISSECTION OF THE FACE.

Fr. Frontalis. *S.O.N.* Supraorbital Nerve. *S.T.N.* Supratrochlear Nerve. *Fr.A.* Frontal Artery. *O.P.M.* Orbicularis Palpebrarum Muscle. *P.N.M.* Pyramidalis Nasi Muscle. *C.N.M.* Compressor Naris Muscle. *L.L.S.A.N.M.* Levator Labii Superioris Alæque Nasi Muscle. *D.N.M.* Depressor Naris Muscles and Lateral Nasal Artery. *L.L.S.P.M.* Levator Labii Superioris Proprius Muscle. *D.F.V.* Deep Facial Vein. *Z.Ma.M.* Zygomaticus Major Muscle. *Z.Mi.M.* Zygomaticus Minor Muscle. *St.D.* Stensen's Duct. *B.5.N.* Buccal Branch of the 5th Nerve. *Ri.M.* Risorius Muscle. *O.O.M.* Orbicularis Oris Muscle. *B.M.* Buccinator Muscle. *D.A.O.M.* Depressor Anguli Oris Muscle. *D.L.I.M.* Depressor Labii Inferioris Muscle. *I.L.A.* Inferior Labial Artery. *F.A.* Facial Artery. *F.V.* Facial Vein. *Pl.* Platysma. *M.M.* Masseter Muscle. *M.7.N.* Mandibular Branch of the Facial Nerve. *P.G.* Parotid Gland. *G.A.N.* Great Auricular Nerve. *B.7.N.* Buccal Branch of the Facial Nerve. *I.O.7.N.* Infraorbital Branch of the Facial Nerve. *Ma.7.N.* Malar Branch of the Facial Nervo. *T.7.N.* Temporal Branch of tho Facial Nerve. *S.T.A.* Superficial Temporal Artery. *A T.N.* Auriculo-temporal Nervo. *S.P.* Socia parotidis.

emerging or entering, while behind, the edge of the sterno-mastoid, the mastoid process, and the antero-inferior wall of the external auditory meatus form its boundary.

Where the lower jaw has been cut and removed, the

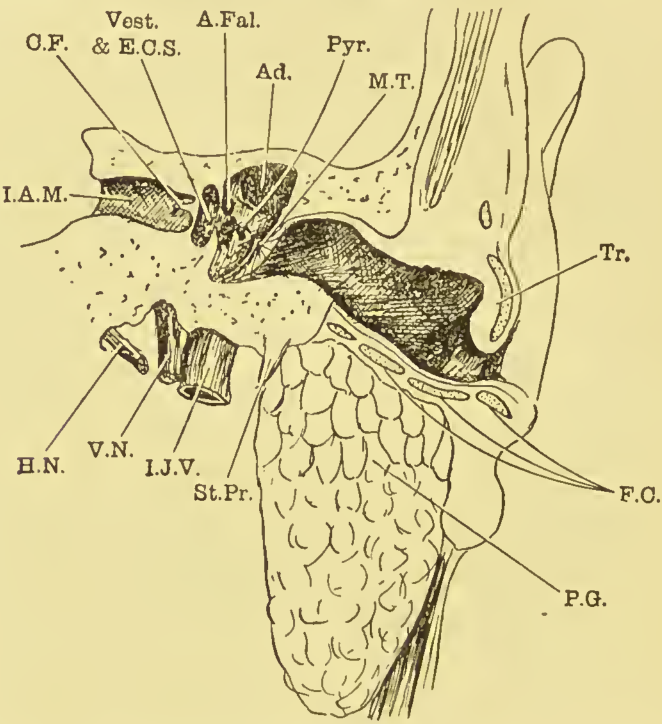


Fig. 72.—Section through the Parotid Gland to show its close Relationship to the External Auditory Meatus.

P.G. Parotid Gland. *F.C.* Plates of Fibro-cartilage. *St.Pr.* Root of Styloid Process. *I.J.V.* Internal Jugular Vein. *V.N.* Vagus Nerve. *H.N.* Hypoglossal Nerve. The key to the other figures will be found on p. 251.

gland shows a deep concavity; in fact, it is wrapped round the posterior border of the ramus and extends forwards both superficially and deeply to it (see Fig. 73).

The superficial projection lies on the surface of the masseter, and may be spoken of as the *masseteric lobe.*

It is here that the duct comes out. The deep projection

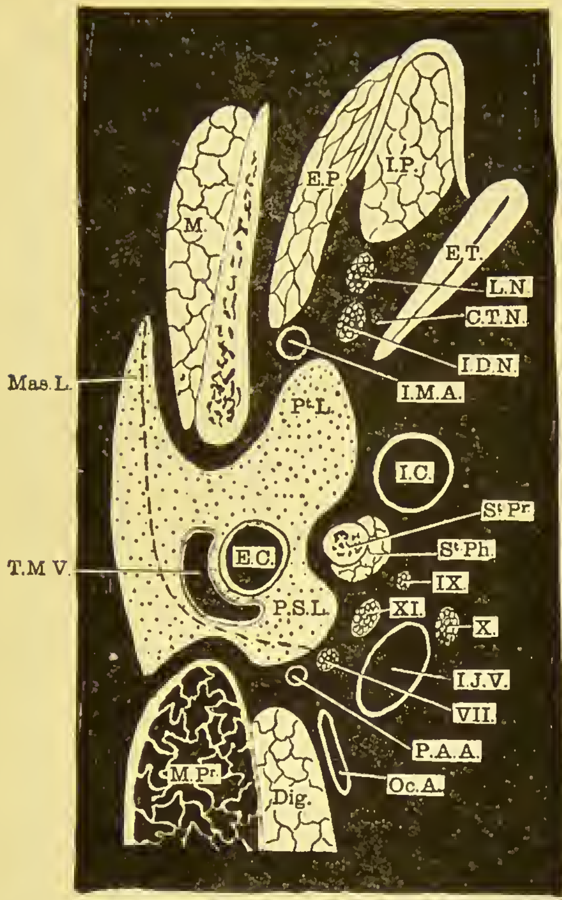


FIG. 73.—HORIZONTAL SECTION THROUGH THE UPPER PART OF THE PAROTID GLAND TO SHOW ITS RELATIONS (DIAGRAMMATIC).

M. Masseter and Ramus of Jaw. *E.P.* External Pterygoid. *I.P.* Internal Pterygoid. *E.T.* Eustachian Tube. *L.N.* Lingual Nerve. *C.T.N.* Chorda Tympani Nerve. *I.D.N.* Inferior Dental Nerve. *I.M.A.* Internal Maxillary Artery. *Mas.L.* Masseteric Lobe of Parotid. *Pt.L.* Pterygoid Lobe of Parotid. *P.S.L.* Post-styloid Lobe of Parotid. *E.C.* External Carotid Artery. *T.M.V.* Temporo-maxillary Vein. The dotted line external to this represents the course of the Facial Nerve. *I.C.* Internal Carotid Artery. $S^t.P^r.$ Styloid Process. $S^t.Ph.$ Stylo-pharyngeus Muscle. *VII., IX., X., XI.* The Corresponding Cranial Nerves. *I.J.V.* Internal Jugular Vein. *P.A.A.* Posterior Auricular Artery. *Oc.A.* Occipital Artery. *Dig.* Posterior Belly of Digastric. *M.Pr.* Mastoid Process.

insinuates itself between the external and internal pterygoid muscles, and is known as the *pterygoid lobe* (see Fig. 75, Pt.L.).

The structures embedded in the gland are:—

1. (Most superficially.) The Preauricular Lymph Nodes, which are very small, and lie in front of the tragus.

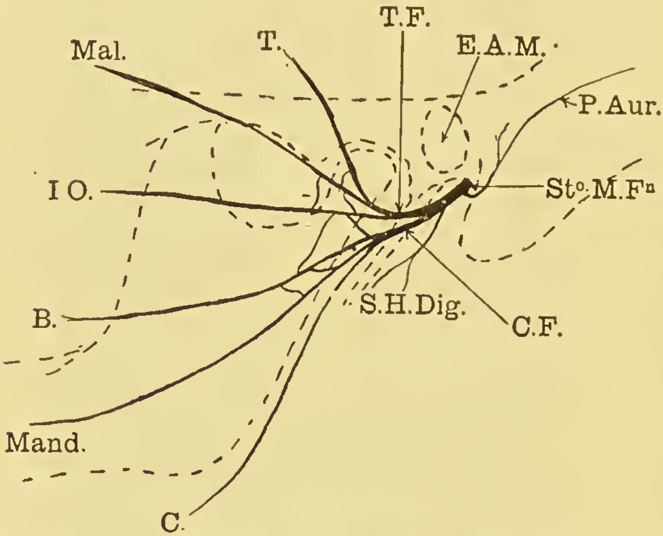


FIG. 74.—DIAGRAM OF THE DISTRIBUTION OF THE FACIAL NERVE.

T.F. Temporo-facial Division of Pes Anserinus. *T.* Temporal Branch. *Mal.* Malar Branch. *I.O.* Infraorbital Branch. *B.* Buccal Branch. *Mand.* Mandibular Branch. *C.* Cervical Branch. *C.F.* Cervico-facial Division of Pes Anserinus. *S.H.Dig.* Branch to Stylo-hyoid and Posterior Belly of Digastric Muscles. *P.Aur.* Posterior Auricular Branch. *E.A.M.* External Auditory Meatus. *St.º M.Fⁿ.* Stylo-mastoid Foramen.

2. The Great Auricular Nerve emerging from the surface of the gland to supply the skin superficial to it.

3. The Facial Nerve, which should be reached by following as many of the facial branches as have been preserved into the gland, and by picking away the glandular substance superficial to them. In this way the *pes anserinus* or plexus of the facial nerve [plexus parotidea] will be exposed, and eventually the main trunk will be followed as far as the

stylo-mastoid foramen, where its branches to the posterior belly of the digastric and the stylo-hyoid muscles should be looked for (see Fig. 74).

4. Cut the branches of the pes anserinus, turn it back, and look for the *Temporo-maxillary Vein*, which is usually, though not always, on a deeper plane (Fig. 73, T.M.V.). It is formed by the junction of the superficial temporal and internal maxillary veins behind the neck of the condyle and emerges from the gland at its lower part, where it usually divides into an anterior and posterior branch. Of these the anterior joins the facial vein to form the common facial, while the posterior joins the posterior auricular to form the external jugular vein. These veins, however, like others, are liable to great variation.

5. On reflecting the veins the *external carotid artery* is seen on a deeper plane (Fig. 73, E.C.A.). It divides into its superficial temporal and internal maxillary branches at the level of the neck of the condyle; the former leaves the gland at its upper part, while the latter comes out at the base of the already-mentioned pterygoid lobe.

6. The *auriculo-temporal nerve*, which lies in the posterior part of the glenoid cavity, may be one of the structures embedded in the parotid, because the gland sometimes sends a process called the *glenoid lobe* up behind the condyle of the jaw. There is no doubt, however, that this lobe, even when it is present, is often non-glandular, and is merely composed of dense fibrous tissue.

The auriculo-temporal nerve has already been found in the pterygoid region as well as on the scalp, so that this connecting part of its course will be easily explored. Notice once more that it passes deep to the superficial temporal artery.

If the body has been injected with formalin, there is now little difficulty in removing the remains of the gland entire, and in noticing the groove on its deep surface made by the styloid process. The gland therefore moulds itself on to the

styloid process in the same way that it does on to the ramus of the jaw and the sterno-mastoid muscle, and it is con-

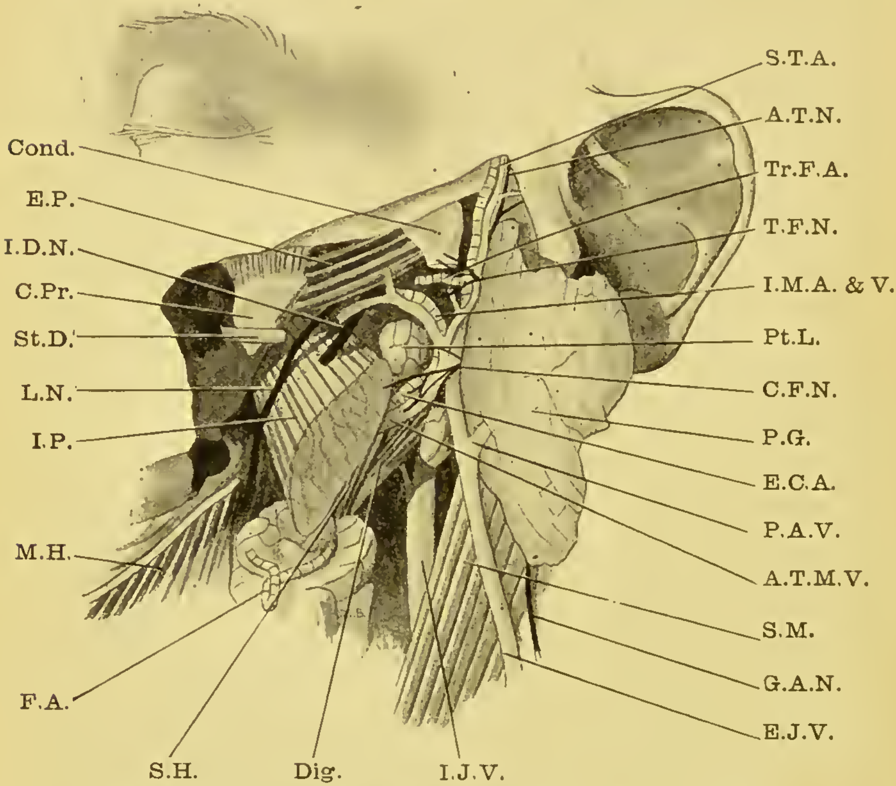


FIG. 75.—DEEP DISSECTION OF THE PAROTID GLAND.

Cond. Condyle of Jaw. *E.P.* External Pterygoid. *I.D.N.* Inferior Dental Nerve. *C.Pr.* Coronoid Process. *St.D.* Stensen's Duct. *L.N.* Lingual Nerve. *I.P.* Internal Pterygoid. *M.H.* Mylo-hyoid Muscle. *F.A.* Facial Artery. *S.H.* Stylo-hyoid. *Dig.* Digastric. *I.J.V.* Internal Jugular Vein. *S.T.A.* Superficial Temporal Artery. *A.T.N.* Auriculo-temporal Nerve. *Tr.F.A.* Transverse Facial Artery. *T.F.N.* Temporo-facial division of 7th Nerve. *I.M.A. & V.* Internal Maxillary Artery and Vein. *Pt.L.* Pterygoid Lobe of Parotid. *C.F.N.* Cervico-facial Division of Facial Nerve. *P.G.* Body of Parotid. *E.C.A.* External Carotid Artery. *P.A.V.* Posterior Auricular Vein. *A.T.M.V.* Anterior Division of Temporo-maxillary Vein. *S.M.* Sterno-mastoid. *G.A.N.* Great Auricular Nerve. *E.J.V.* External Jugular Vein.

venient to speak of the anterior and posterior lips of the groove as the *pre-styloid* and *post-styloid* lobes.

It is at the upper and back part of the post-styloid lobe that the facial nerve enters the gland, while just behind this lobe the posterior auricular artery is partly embedded.

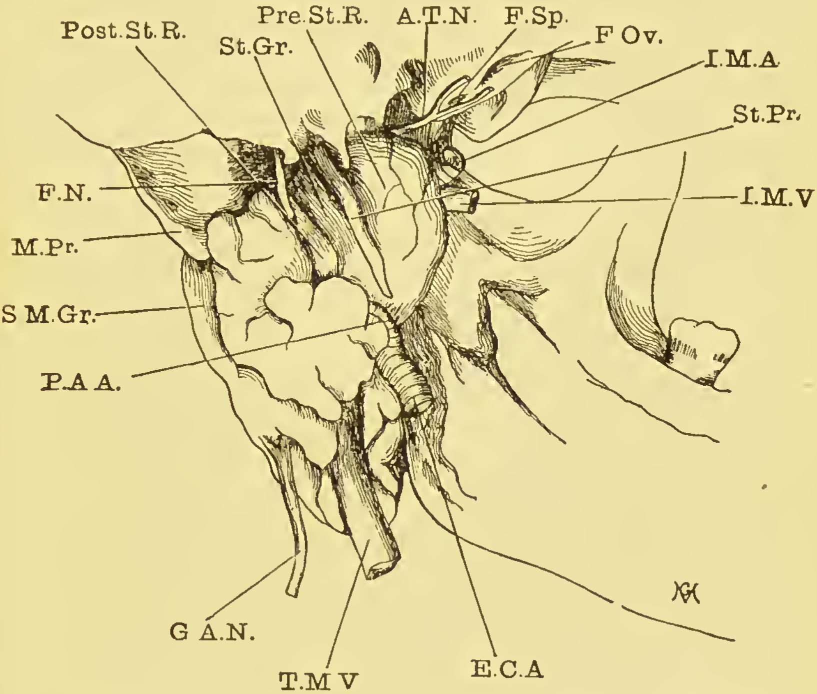


FIG. 76.—PAROTID GLAND, SEEN FROM THE INNER SIDE. THE GLAND HAS BEEN DISSECTED OUT ENTIRE AND FITTED ON TO A DRY SKULL.

Post.St.R. Post-styloid Ridge or Lobe. *St.Gr.* Styloid Groove. *Pre.St.R.* Pre-styloid Ridge or Lobe. *A.T.N.* Auriculo-temporal Nerve. *F.Sp.* Foramen Spinosum. *F.Ov.* Foramen Ovale. *I.M.A.* Internal Maxillary Artery. *I.M.V.* Internal Maxillary Vein. *E.C.A.* External Carotid Artery. *T.M.V.* Temporo-maxillary Vein. *G.A.N.* Great Auricular Nerve. *P.A.A.* Posterior Auricular Artery. *S.M.Gr.* Groove for Sterno-mastoid Muscle. *M.Pr.* Mastoid Process. *F.N.* Facial Nerve.

At the lower part of the post-styloid lobe the external carotid artery enters the gland, so that this lobe is worthy of special attention (see Fig. 76).

On looking at the hollow from which the gland has been removed, it will be noticed that the internal jugular vein,

with the 9th, 10th, and 11th cranial nerves, lie just internal to the part which was occupied by the post-styloid lobe (Fig. 73).

A final review of the Parotid Gland will show that its shape is that of an inverted pyramid, having four surfaces, a base, and an apex.

Of the surfaces the anterior is grooved for the mandible, the posterior for the mastoid process and sterno-mastoid muscle, while the internal has an oblique groove for the styloid process.

The apex is at the angle of the jaw, and is separated from the submaxillary gland by the *stylo-mandibular ligament.*

DEEP DISSECTION OF THE NECK

In order to see the deep parts of the neck clearly the inner end of the clavicle should be removed, and, before this is done, the opportunity must be seized of examining the joint between it and the sternum.

Notice that the STERNO-CLAVICULAR ARTICULATION has a capsule, of which the anterior part is the thickest, and consists of fibres running downwards and inwards, while the two clavicles are joined together above the manubrium by the *interclavicular ligament*, the lower fibres of which blend with the upper part of each capsule.

Pull up the outer cut end of the clavicle and look for the *costo-clavicular* or *rhomboid ligament* running downwards and inwards from the inner part of the lower surface of its shaft to the first rib cartilage.

Notice that the outer end of the clavicle can be elevated or depressed, pulled forwards or pushed backwards, and rotated, though very slightly, on its long axis.

For all practical purposes, the only movements which take place within the capsule are slight gliding ones, and so the joint is said to belong to the subdivision of the Arthrodia or gliding joints and to the main division of Diarthroses or movable joints.

Now cut through the capsule from above, keeping close

to the sternum. This will open a synovial cavity, but the clavicle does not bound it externally, because there is an interarticular fibro-cartilage or meniscus [discus articularis] which is attached to the clavicle above and to the junction of the first rib cartilage with the sternum below, while in front and behind it blends with the capsule. This may be demonstrated by cutting through the capsule on the outer

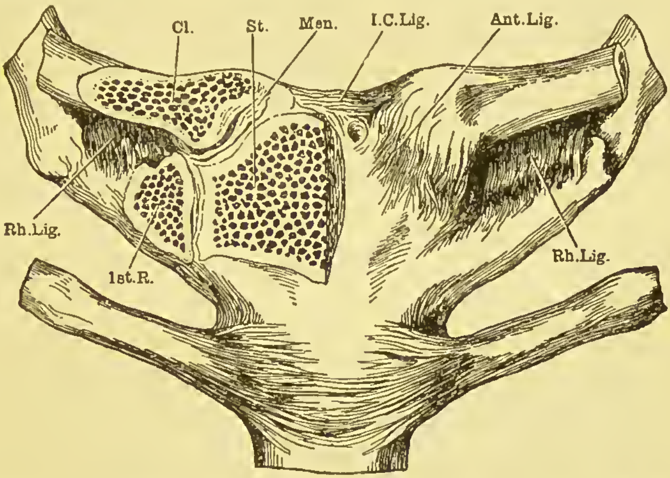


FIG. 77.—STERNO-CLAVICULAR ARTICULATION. A CORONAL SECTION HAS BEEN MADE ON THE RIGHT SIDE.

Ant.Lig. Anterior Ligament. *I.C.Lig.* Interclavicular Ligament. *Men.* Meniscus. *St.* Sternum. *Cl.* Clavicle. *Rh.Lig.* Rhomboid Ligament. 1*st.R.* First Rib.

side of the meniscus, and noticing that the two synovial cavities are quite separate.

The posterior part of the capsule is just like the anterior, except that it is not so strong.

Disarticulate the clavicle by cutting through the meniscus, the remains of the capsule, and the costo-clavicular ligament. When this is done the clavicle, or what is left of it by the dissectors of the upper extremity, may be lifted up with the sterno-mastoid attached, but great care should be taken in freeing the clavicle not to injure the subclavian and innominate veins which lie just behind it.

As soon as the sternal origin of the sterno-mastoid is divided, the muscle, with the inner end of the clavicle attached, may be carefully reflected up to its insertion, but can be replaced whenever it is necessary to verify relations.

Just as a study of the more superficial relations of the common carotid artery and its branches brings the dissector into touch with the structures in the anterior triangle, so a study of their deeper relations forms a useful method of approaching the deeper parts of the neck.

Posterior or Deep Relations of the Common Carotid Artery in the Neck

Bones.—The transverse processes of the 4th, 5th, and 6th cervical vertebræ.

Muscles.—The prevertebral muscles attached to these transverse processes, namely, the longus colli, rectus capitis anticus major, and scalenus anticus.

Fibrous Structures.—Cellular tissue forming the posterior part of the carotid sheath.

Arteries.—The inferior thyroid and its ascending cervical branch.

Veins.—None.

Nerves.—Vagus with cardiac branches, Sympathetic with cardiac branches, Recurrent Laryngeal on right side.

The anterior tubercles of the transverse processes should be localised at once; the 4th and 5th often lie a little internal to, as well as behind, the artery, the former being at the level of the bifurcation. The 6th is said to be the largest, and is often known as the *carotid tubercle,* since against it the common carotid may be effectively compressed.

Of the muscles the longus colli lies in front of the bodies of the vertebræ, and the rectus capitis anticus major runs up in front of the transverse processes. They will both be seen much better later on.

The *Scalenus anticus* [M. scalenus anterior], however, is now thoroughly exposed, and should be carefully studied, since its relations are numerous and important. It is attached above to the anterior tubercles of the transverse

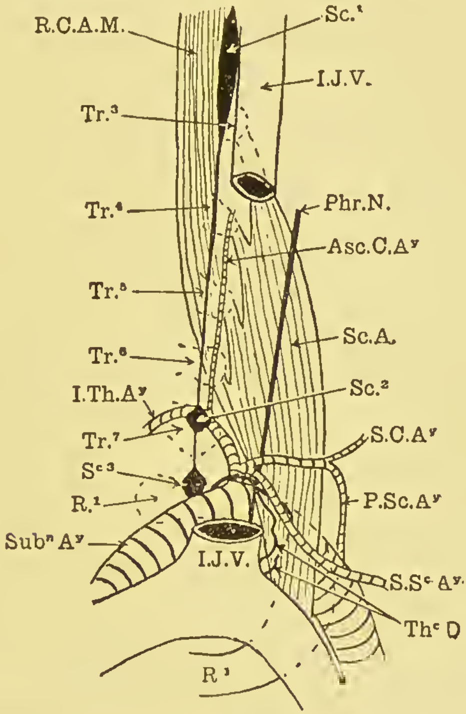


FIG. 78.—ANTERIOR RELATIONS OF THE SCALENUS ANTICUS MUSCLE.

*Sc*¹., *Sc*²., *Sc*³. Cervical Ganglia of the Sympathetic. *I.J.V.* Internal Jugular Vein. *Phr.N.* Phrenic Nerve. *Asc.C.Aʸ.* Ascending Cervical Artery. *Sc.A.* Scalenus Anticus. *S.C.Aʸ.* Superficial Cervical Artery. *P.Sc.A.* Posterior Scapular Artery. *S.Sc.A.* Suprascapular Artery. *Thᶜ.D.* Thoracic Duct in two Branches. *Subⁿ.Aʸ.* Subclavian Artery. *R*¹. First Rib. *I.Th.Aʸ.* Inferior Thyroid Artery. *Tr*³., *Tr*⁴., *Tr*⁵., *Tr*⁶., *Tr*⁷. Anterior Tubercles of Transverse Processes of Cervical Vertebræ. *R.C.A.M.* Rectus Capitis Anticus Major.

processes of the 3rd, 4th, 5th, and 6th cervical vertebræ, and runs down and out to the scalene tubercle on the inner part of the upper surface of the first rib. In front of this muscle is the clavicle, which may be replaced for the moment; and

the sterno-mastoid, the outer edge of which, as has been seen, corresponds to the outer edge of the anterior scalene below. Then the tendon of the omo-hyoid crosses on its way from the posterior to the anterior triangle of the neck. It is here that it is said to be bound down to the first rib by a loop of deep cervical fascia, which should be looked for very carefully.

In addition to the common carotid, the *transversalis colli* and *suprascapular arteries* run horizontally out in front of the scalenus anticus, and these may now be traced inwards to their origin from the thyroid axis.

The *Thyroid axis* [truncus thyreo-cervicalis] is a short trunk which lies immediately to the inner side of the scalenus anticus, comes off the first part of the subclavian artery, and is often overlapped by the internal jugular vein. As this vein has already been studied, it may be divided and its lower part turned down, but great care must be taken here, because on the left side the *thoracic duct* lies behind the lower part of the internal jugular and close to the inner side of the thyroid axis, while on the right side the *right lymphatic duct*, when present as a single distinct vessel, occupies the same position. Besides the transversalis colli and suprascapular arteries, the thyroid axis gives off the *inferior thyroid artery*, which runs upwards and inwards behind the carotid vessels (see Fig. 78).

Now examine the veins of this region. The lower end of the internal jugular vein, if traced down, will be seen to join the subclavian close to the inner border of the scalenus anticus, and well behind the clavicle, about an inch from the sterno-clavicular articulation. It is here that the vein may be auscultated and the venous pulse observed.

The whole of the subclavian vein is now exposed, and its length is a good deal less than that of the artery.

The artery, as has been seen, is divided into three parts by the scalenus anticus, and so is the vein, although the vein lies in front of the muscle, while the artery is behind; but

now that the elavicle is removed, it is evident that the parts of the vein internal to and external to the sealenus antieus are extremely short; indeed the former is usually non-existent (see Fig. 78).

The opening of the external jugular vein into the outer part of the subelavian vein, whieh was hidden by the elavicle in the disseetion of the posterior triangle, is now seen, and

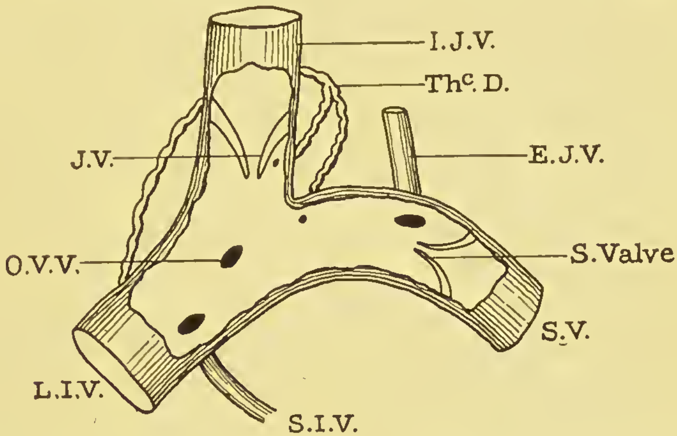


Fig. 79.—Diagram of the Great Veins at the Root of the Left Side of the Neck laid open.

I.J.V. Internal Jugular Vein. *E.J.V.* External Jugular Vein. *I.J.Valve.* Internal Jugular Valve. *Th^c.D.* Thoracic Duct. *S.V.* Subclavian Vein. *S.Valve.* Its Valve. *L.I.V.* Left Innominate Vein. *S.I.V.* Superior Intercostal Vein. *V.V.* Opening of Vertebral Vein.

joining it, elose to its termination, is the *suprascapular vein* [V. transversa seapulæ] running inwards behind the elavicle, and possibly the *transversalis colli vein* [V. transversa eolli], as well as in most cases the *anterior jugular*, whieh passes in front of the common earotid and internal jugular from the mid line of the neck and runs deep to the sterno-mastoid, between it and the sealenus antieus museles.

The lower part of the internal jugular and the whole of the subclavian vein should now be slit open and cleaned out. Just above its junction with the subelavian the internal jugular shows a well-marked bicuspid valve, and under cover

of the outer eusp is the commonest plaee for the opening of the *thoracic duct* on the lcft side (see Fig. 79).

In more than 50 pcr eent. of all eases this duet is double for some little way before its termination. Sometimes the two parts join again before their opening, at others they open separately, and then the seeond aperture may be above or below the point named. This duplieation of the duet is probably of considerable importanee in operative surgery, beeause, if one is aecidentally eut, the other will still carry the ehyle into the veins.

Direetly below the junetion of the internal jugular and subelavian veins is the usual point of opening of the vertebral vein, while in the subclavian vein, about an ineh outside its junetion with the internal jugular, is another well-marked bicuspid valve.

Turn the eut internal jugular down and look for the *vertebral vein* which lies direetly behind it. This vein eomes out of the foramen in the transverse proeess of the sixth eervieal vertebra, and generally passes in front of the thoracie duet, whieh, if it has not already been seen on the left side, must be looked for very earefully now. The vein often reeeives, near its termination, the intereostal vein from the first spaee (highest intereostal), though this sometimes opens into the innominate.

Behind the internal jugular, whieh has been turned down, is the *first part of the subclavian artery*, differing somewhat on the two sides. On the right its origin from the innominate will be seen behind the sterno-elavieular artieulation, but on the left the earotid and subclavian are separate branehes of the areh of the aorta. In front of this part of the artery look for the *vagus* and *phrenic nerves*. The former runs down quite close to the earotid artery, and so passes in front of the inner end of the first part of the subelavian; indeed, on the left side the vagus is rather an anterior relation of the subclavian in the thorax than in the neck.

The *Phrenic*, on the other hand, lies quite close to the inner edge of the scalenus anticus, and therefore in front of the outer end of the first part of the subclavian artery (see Fig. 80).

On the right side the *recurrent laryngeal nerve* leaves the vagus and loops back beneath the first part of the subclavian artery, while on both sides a rather delicate loop of cervical sympathetic chain passes in front of the artery and joins the middle to the inferior cervical ganglion. This is known as the *Annulus of Vieussens* [ansa subclavia]. The dissector will do well, however, not to expect any great uniformity in the arrangement of the cervical sympathetic.

In addition to the thyroid axis, the first part of the subclavian gives off the vertebral and the internal mammary branches.

The *vertebral artery* is almost always the first branch of the subclavian; indeed it is a fairly common abnormality to find it coming off on the left side from the arch of the aorta, between the origins of the left carotid and subclavian arteries. This artery is divided into four stages: (1) At the root of the neck; (2) in the vertebrarterial foramina in the transverse processes of the upper six cervical vertebræ; (3) in the suboccipital triangle; and (4) within the dura mater. These four parts are met with in different stages of the dissection of the head and neck, and it is only the first part which concerns us here.

The first part of the vertebral artery runs up in front of the transverse process of the seventh cervical vertebra to gain the foramen in the transverse process of the sixth. In its course, which is often tortuous, it passes behind the vertebral vein, and both of them are crossed by the inferior thyroid artery (see Fig. 48, p. 100). Unless he is careful the dissector is liable to cut the latter artery in cleaning the vertebral. The vertebral vein should be cut and turned down, and then the thoracic duct on the left side may be traced inwards, usually lying between the vertebral artery and vein. It was in this part of its course that the verte-

bral artery used to be ligatured, and the risk of injuring the duct was then great. Now, however, ligature of the vertebral is one of the rarest of surgical operations. On the other hand, that of the inferior thyroid artery is becoming increasingly common in the treatment of goitre. On the

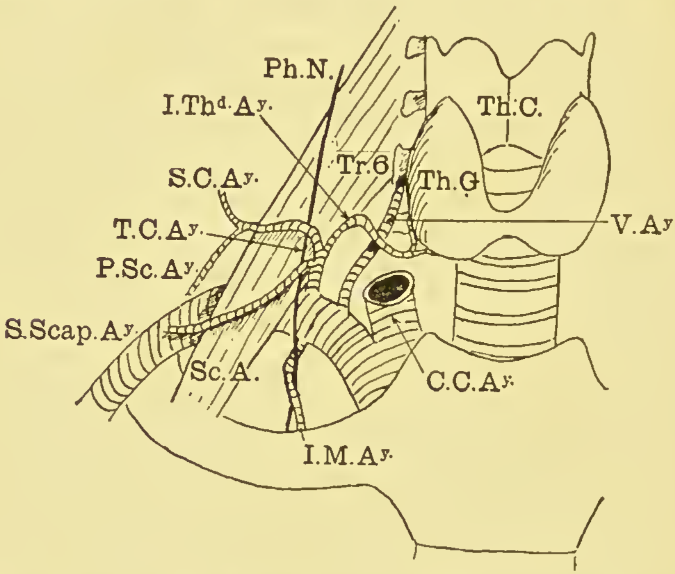


Fig. 80.—Diagram of the Branches of the First Part of the Subclavian Artery.

Th.C. Thyroid Cartilage. *Th.G.* Thyroid Gland. *V.A^{y}.* Vertebral Artery. *Ph.N.* Phrenic Nerve. *I.Th^{d}.A^{y}.* Inferior Thyroid Artery. *S.C.A^{y}.* Superficial Cervical Artery. *T.C.A^{y}.* Phrenic Nerve just below Transversalis Colli Artery. *S.Scap.A^{y}.* Suprascapular Artery. *Sc.A.* Scalenus Anticus. *I.M.A.* Internal Mammary Artery. *Tr.*6. Carotid Tubercle of 6th Cervical Vertebra. *C.C.A^{y}.* Common Carotid Artery.

inner side of the artery is the longus colli muscle, on its outer the scalenus anticus and thyroid axis.

It will now be seen that the *thoracic duct,* usually in two parts, makes a loop over the left subclavian artery in front of the root of the vertebral artery and behind the vertebral vein, and it is in the course of this loop that it receives the *jugular duct* running down from the deep cervical nodes and, more externally, the *subclavian duct* coming inwards

from the *supraclavicular nodes* in the lower part of the posterior triangle. Both these ducts may with care be identified.

The next thing to look for is the origin of the *internal mammary artery* which comes off opposite that of the thyroid axis and runs downwards and inwards behind the formation of the innominate vein and a little outside the position of the sterno-clavicular articulation.

At its origin it is usually crossed obliquely by the phrenic nerve, which is here lying behind the innominate vein at its formation and in front of the internal mammary artery. If possible, an arrangement should be made with the dissectors of the thorax to display the whole course of the artery. As soon as the pleural cavity has been opened, a finger should be passed up into its dome, and it will then be felt that the pleura covers both the lower and posterior surfaces of the first part of the subclavian artery as well as the posterior surface of the internal mammary (see Fig. 80).

The posterior relations of the common carotid artery must now be resumed.

The nerves which lie behind the common carotid are the vagus, the sympathetic, and, on the right side, the recurrent laryngeal. The course of the *vagus* with its cardiac branches has been studied in part (see p. 98), and may be now followed right up to the skull. Above the bifurcation of the common carotid artery it lies between the internal jugular vein and the internal carotid artery, and, as the level of the atlas is approached, is in close relation to the hypoglossal nerve. Here it slightly enlarges to form the ganglion of the trunk [ganglion nodosum], which is often nearly an inch long, and receives a communication from the superior cervical ganglion of the sympathetic.

On looking at the base of a dried skull it will be noticed that the anterior condylar foramen [canalis hypoglossi], through which the hypoglossal nerve emerges, lies internal to the jugular foramen, which gives exit to the vagus among

other structures. Consequently the hypoglossal approaches the vagus from its inner side. In front of the transverse process of the atlas the hypoglossal is lying behind the ganglion of the trunk of the vagus and is closely bound to

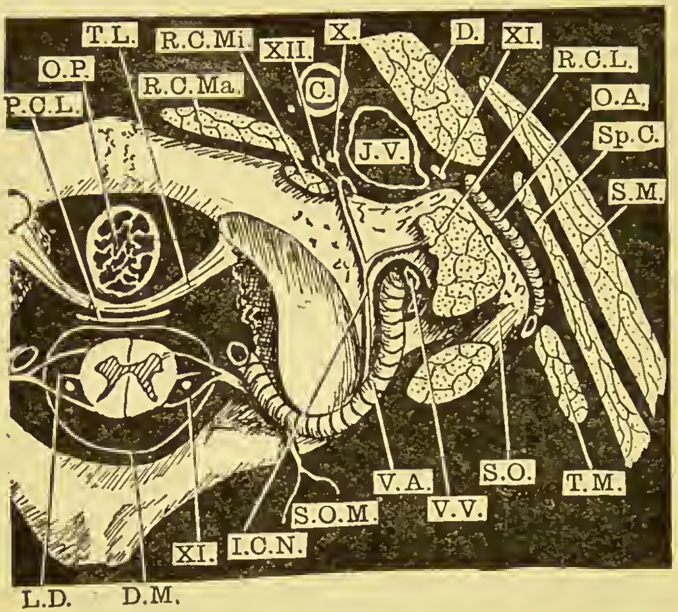


FIG. 81.—DIAGRAM OF THE ATLAS AND ITS RELATIONS SEEN FROM ABOVE.

O.P. Odontoid Process. *T.L.* Transverse Ligament. *P.C.L.* Posterior Common Ligament. *R.C.Ma.* Rectus Capitis Anticus Major. *R.C.Mi.* Rectus Capitis Anticus Minor. *C.* Internal Carotid Artery. *J.V.* Internal Jugular Vein. *XII.* Hypoglossal Nerve. *X.* Vagus Nerve. *XI.* Spinal Accessory Nerve. *R.C.L.* Rectus Capitis Lateralis. *O.A.* Occipital Artery. *Sp.C.* Splenius Capitis. *S.M.* Sterno-mastoid. *T.M.* Trachelo-mastoid. *S.O.* Superior Oblique Muscle. *V.V.* Vertebral Vein. *V.A.* Vertebral Artery. *S.O.N.* Suboccipital Nerve. *I.C.N.* First Cervical Nerve (Anterior Primary Division). *D.M.* Dura Mater. *L.D.* Ligamentum Dentatum.

it, exchanging a few fibres, while still lower the hypoglossal becomes external (superficial) to the vagus. It thus describes half a spiral round the vagus (see Fig. 81).

It is just in front of the atlas that a loop of communication is formed between the first and second cervical nerves,

and from this loop, though mainly derived from the first cervical nerve, some reinforcing fibres are given off to the hypoglossal, which is here behind the vagus. It is this communication which really deserves the name of the communicans hypoglossi, and these are the fibres which come off the hypoglossal again, lower down, as the ramus descendens hypoglossi, the nerve to the thyro-hyoid, and the nerve to the genio-hyoid.

Sometimes the vagus, instead of the hypoglossal, picks up the communication from the first cervical, and in that case the ramus descendens hypoglossi is a branch of it and is really a ramus descendens vagi. This is a fairly common occurrence.

From the ganglion of the trunk the vagus gives off its *pharyngeal* and *superior laryngeal branches*. The former passes inwards between the external and internal carotid arteries to the pharyngeal plexus, the latter passing deep to both carotids and, in doing so, dividing into *external* and *internal laryngeal nerves*, which have already been found (see p. 103).

The *cervical part of the Sympathetic Cord* lies behind the common and internal carotid arteries and in front of the transverse processes of the cervical vertebræ, quite close to the groove which marks the division between the rectus capitis anticus major and scalenus anticus muscles. It is therefore a close relation to the ascending cervical branch of the inferior thyroid artery. Of its three ganglionic swellings, the *Superior Cervical Ganglion* [G. cervicale superius] is by far the largest, often having a length of 1½ inch; it is easily recognised by its dark colour and fusiform shape, and is found in front of the transverse processes of the second and third cervical vertebræ.

Above, it gives off one or two branches which run up with the internal carotid artery into the skull.

Externally, twigs of communication with the four upper cervical nerves must be looked for, while, although it is difficult to see, it is very important to realise that a sym-

pathetic plexus extends up the external carotid artery and along its various branches from the ganglion.

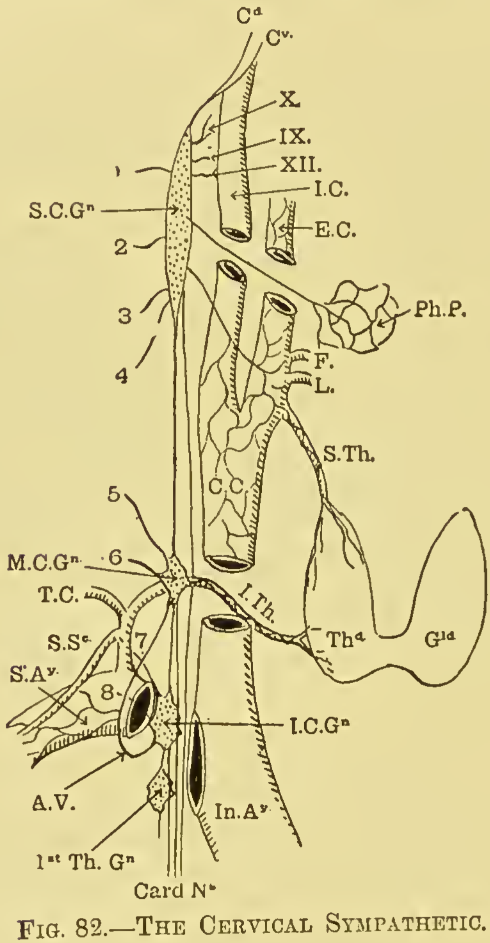


FIG. 82.—THE CERVICAL SYMPATHETIC.

Cd. Branch to Carotid Plexus. *Cv*. Branch to Cavernous Plexus. *IX., X., and XII.* Communications with corresponding Cranial Nerves. *I.C.* Internal Carotid Artery. *E.C.* External Carotid Artery. *Ph.P.* Pharyngeal Plexus. *F.* Facial Artery. *L.* Lingual Artery. *S.Th.* Superior Thyroid Artery. *Thd.Gld*. Thyroid Gland. *I.Th.* Inferior Thyroid Artery with Sympathetic Plexus. *In.Av*. Innominate Artery. *S.C.G.* Superior Cervical Ganglion. 1, 2, 3, 4, 5, 6, 7, 8. Communications with Cervical Nerves. *S.C.Gn*. Superior Cervical Ganglion. *M.C.Gn*. Middle Cervical Ganglion. *I.C.Gn*. Inferior Cervical Ganglion. *T.C.* Transversalis Colli Artery. *S.Sc*. Suprascapular Artery. *S.Av*. Subclavian Artery. *A.V.* Annulus of Vieussens. *Card.Ns*. Cardiac Nerves.

Internally are communicating twigs with the glosso-pharyngeal, vagus, and hypoglossal nerves, the search for which may be deferred until later.

In addition to these are *pharyngeal* and *laryngeal branches*, joining the corresponding branches of the vagus, and the *superior cervical cardiac branch* of the sympathetic, which runs down behind the carotid, and on the right side may pass either superficial or deep to the first part of the subclavian artery. On the left side it is always superficial, since it goes to the superficial cardiac plexus.

The *middle cervical ganglion* [G. cervicale medium] is a long way below the upper and is much smaller. It usually lies just in front of the highest convexity of the inferior thyroid artery at the level of the sixth cervical vertebra, and has communication with the fifth and sixth cervical nerves. These are not difficult to find, and, li..e all the other cervical rami communicantes, only contain grey or non-medullated fibres which pass from the ganglion to the spinal nerves. No white rami communicantes are found in the neck.

Internally, delicate vasomotor twigs follow the inferior thyroid artery to the thyroid gland.

A *middle cervical cardiac* nerve runs down from thc ganglion to the deep cardiac plexus, though this branch may come from the connective or main cord of the sympathetic above or below the ganglion. The middle cervical ganglion is very variable in position and size, and often lics deep instead of superficial to the inferior thyroid artery.

The *Inferior Cervical Ganglion* [G. cervicale inferius] lies behind the first part of thc subclavian artery, near the origin of the vertebral. To see it the subclavian artery should be cut through just internal to the origin of the thyroid axis, and hooked inwards. This ganglion lies between the transverse process of the seventh cervical vertebra and the head of the first rib, and is often fused with the first thoracic ganglion, which lies a little lower down. It gives

grey rami communicantes to the seventh and eighth cervical nerves, as well as vasomotor twigs to the vertebral and internal mammary arteries, and an *inferior cervical cardiac branch*, which is sometimes fused with the middle cervical cardiac, to the deep cardiac plexus. The annulus of Vieussens, already noticed, communicates with this ganglion, but this loop is not always present and gives off no branches of any importance.

Now that the first part of the subclavian artery is reflected, its posterior relations in the neck may be studied.

Posterior Relations of First Part of Subclavian Artery

Bones.—Head and neck of first rib are quite half an inch away.

Muscles.—Longus colli.

Fibrous Structures.—Sibson's Fascia, covering the dome of the pleura.

Arteries and Veins.—None.

Nerves.—Inferior Cervical and First Thoracic Ganglia of Sympathetic with most of the Cardiac Nerves. Recurrent Laryngeal on right side only.

Glandular and other Structures.—Dome of Pleura.

The next thing is to study the formation of the *Cervical Plexus*. This is formed by the upper four cervical nerves, each of which emerges from the spinal canal above its own vertebra, and not below as in the thoracic and lumbar regions. These four nerves are joined together by three communicating loops, the first of which passes in front of the transverse process of the atlas, while the lower two lie in front of the levator anguli scapulæ and scalenus medius.

The most easy way to understand this plexus is to recognise that all the sensory fibres form a superficial part,

while the motor and communicating fibres form a deep part.

In the superficial plexus those nerves coming from the second and third cervical give off three ascending branches—the small occipital, great auricular, and transverse cervical; while those coming from the third and fourth descend and become the suprasternal, supraclavicular, and supra-acromial

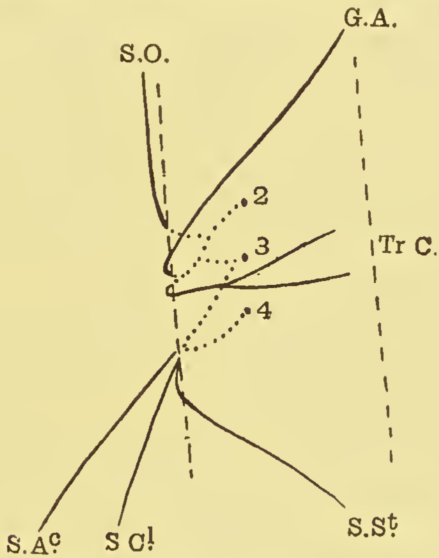


FIG. 83.—SUPERFICIAL CERVICAL PLEXUS OF RIGHT SIDE.

2, 3, *and* 4. Respective Cervical Nerves. *S.O.* Small Occipital. *G.A.* Great Auricular. *Tr.C.* Transverse Cervical. *S.A^c.* Supra-acromial. *S.C^l.* Supraclavicular. *S.S^t.* Suprasternal. The dotted line is the outline of the sterno-mastoid muscle.

nerves. All these emerge deep to the posterior border of the sterno-mastoid, and have already been studied.

Of the *deep part of the plexus* some branches run in towards the anterior triangle and some out towards the posterior. They are all either muscular or communicating.

Those running inwards consist of—

A. Muscular twigs to the prevertebral muscles. Some of these from the four upper cervical nerves go to the rectus capitis anticus major, while from the first cervical is a

branch to the rectus capitis anticus minor. From the second, third, and fourth are branches to the longus colli, to see which the outer edge of the muscle should be raised.

B. Communicating branches running inwards are—(1) communicating to the hypoglossal; (2) communicating to the superior cervical ganglion of the sympathetic, already

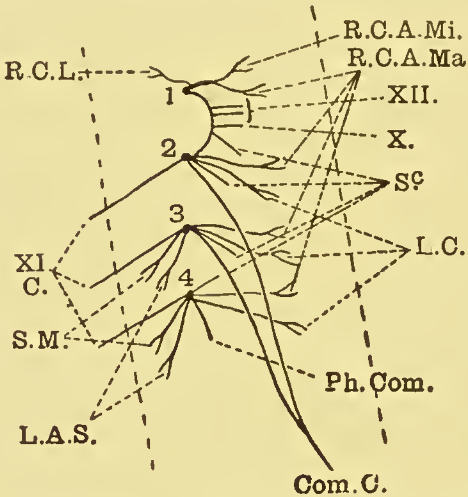


FIG. 84.—DIAGRAM OF THE DEEPER PORTION OF THE RIGHT CERVICAL PLEXUS.

1, 2, 3, and 4 are the Anterior Primary Divisions of the Respective Cervical Nerves. *R.C.A.Mi.* Twigs to Rectus Capitis Anticus Minor. *R.C.A.Ma.* Twigs to Rectus Capitis Anticus Major. *R.C.L.* Twigs to Rectus Capitis Lateralis. *X., XI., and XII.* Communications to Vagus, Spinal Accessory, and Hypoglossal respectively. *S^c.* Communications to Superior Cervical Ganglion of Sympathetic. *L.C.* Twigs to Longus Colli. *Ph.Com.* Phrenic Communicating. *Com.C.* Rami Communicantes Cervicis. *S.M.* Twigs to Scalenus Medius. *L.A.S.* Twigs to Levator Anguli Scapulæ.

noticed; (3) communicating to the vagus; and (4) the ramus communicans cervicis formed by a branch from the second and another from the third cervical nerves, and easily traceable up from the ansa cervicis.

The *branches running outwards* from the deep part of the plexus are—

A. Muscular branches to the rectus capitis lateralis from

the first and to the scalenus medius and levator anguli scapulæ from the third and fourth.

B. Spinal accessory communicating branches from the second, third, and fourth cervical nerves. These either join the spinal accessory directly or form a plexus, with branches of that nerve from which the sterno-mastoid and trapezius are supplied.

Now that the sterno-mastoid and posterior belly of the digastric muscle have been reflected, the *occipital artery* may be followed a step further. It will be found running upwards and backwards to the interval between the tip of the mastoid process and the transverse process of the atlas, and it should be noticed that both these bony points may be touched with the opposite sides of the index finger-tip at the same time.

Running up from the transverse process of the atlas to the jugular process of the occipital bone, which is internal to the mastoid process, is the *rectus capitis lateralis muscle*, and on the outer side of this the occipital artery crosses the muscle diagonally from its antero-inferior to its postero-superior angle (see Fig. 81).

The artery is still deep to the digastric and, on reaching the base of the skull, lies in the groove on the mastoid portion of the temporal bone just internal to the digastric fossa, from which the posterior belly of the digastric rises.

A dried skull should be at hand, and it will be noticed that when the artery reaches the suture between the mastoid portion of the temporal and the occipital bones it is close to the mastoid foramen, through which it sometimes sends a *posterior meningeal artery*, though, as the foramen is not always present, this branch is inconstant.

As soon as the occipital bone is reached the occipital artery lies superficial to the insertion of the superior oblique muscle, which is just behind the rectus capitis lateralis; here it lies deep to the insertions of the splenius capitis and trachelo-mastoid muscles, and is continuous with that part

of the artery which has been dissected already in the sub-occipital region.

The *posterior auricular artery* rises, as has been noticed,

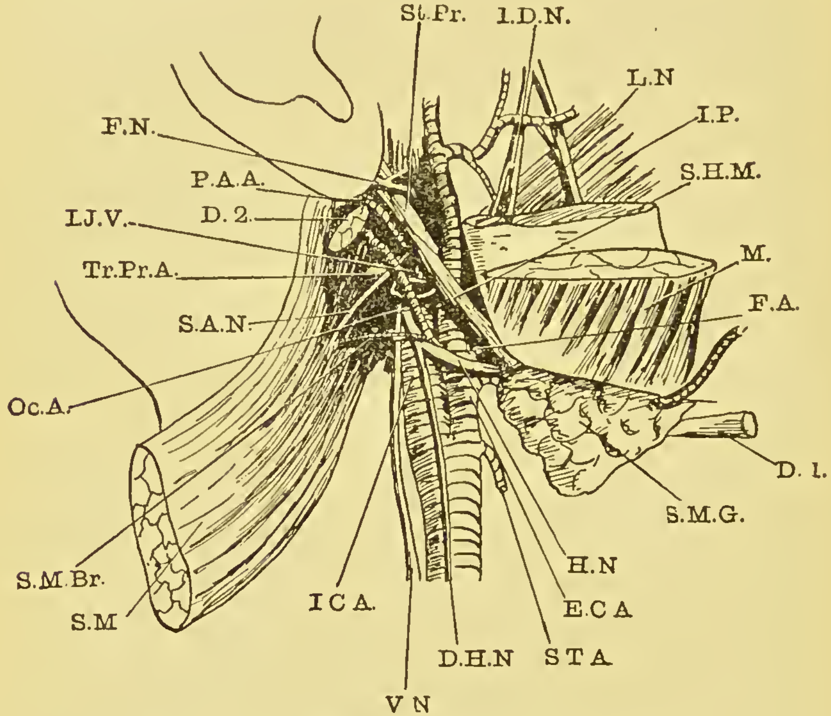


FIG. 85.—COURSE OF THE OCCIPITAL ARTERY.

St.Pr. Styloid Process. *I.D.N.* Inferior Dental Nerve. *L.N.* Lingual Nerve. *I.P.* Internal Pterygoid. *S.H.M.* Stylo-hyoid Muscle. *M.* Masseter. *F.A.* Facial Artery. *D.*1. Anterior Belly of Digastric. *D.*2. Posterior Belly of Digastric. *S.M.G.* Submaxillary Gland. *H.N.* Hypoglossal Nerve. *E.C.A.* External Carotid Artery. *S.T.A.* Superior Thyroid Artery. *D.H.N.* Descendens Hypoglossi Nerve. *V.N.* Vagus Nerve. *I.C.A.* Internal Carotid Artery. *S.M.* Sterno-mastoid. *S.M.Br.* Sterno-mastoid Branch of Occipital Artery. *Oc.A.* Occipital Artery. *S.A.N.* Spinal Accessory Nerve. *Tr.Pr.A.* Transverse Process of Atlas. *I.J.V.* Internal Jugular Vein. *P.A.A.* Posterior Auricular Artery. *F.N.* Facial Nerve.

above the origin of the occipital and runs upwards and backwards behind the styloid process; indeed, the styloid process has practically the same relations as the neck part

of the artery. It is frequently embedded in the post-styloid lobe of the parotid gland (see p. 153), and in removing the gland a piece of the posterior auricular artery is often cut out with that structure.

The artery reaches the skull close to the stylo-mastoid foramen, through which it sends a branch into the aqueductus Fallopii. Here, of course, the posterior auricular artery crosses deep to the facial nerve.

In its upward course it will be seen to cross superficial to the internal jugular vein, internal carotid artery, and the spinal accessory nerve, and it will be noticed that whereas the occipital artery is in relation with the lower border of the posterior belly of the digastric muscle, the posterior auricular runs close to the upper border of that muscle (see Fig. 85).

Between the external auditory meatus and the mastoid process the artery becomes superficial, after which it divides into its auricular and occipital branches.

The *spinal accessory nerve* [N. accessorius] is a very obvious structure, and should be picked up where it enters the deep surface of the sterno-mastoid, usually about the level of the angle of the jaw, or an inch below the tip of the mastoid process, which is the guide most often used by the surgeon. Close to the base of the skull it emerges just in front of the internal jugular vein, and then runs downwards and backwards superficial to that structure and deep to the posterior auricular and occipital arteries as well as to the posterior belly of the digastric (see Fig. 86).

Its course on the surface of the neck may be marked by taking a point midway between the angle of the jaw and the tip of the mastoid process and another half-way down the posterior border of the sterno-mastoid. A line joining these two points and prolonged to the anterior border of the trapezius will approximately correspond to that of the nerve.

The relation of the spinal accessory to the transverse

process of the atlas is variable; sometimes it passes just above this, in which case it forms an X, with the occipital artery on the outer side of the rectus capitis lateralis, the nerve

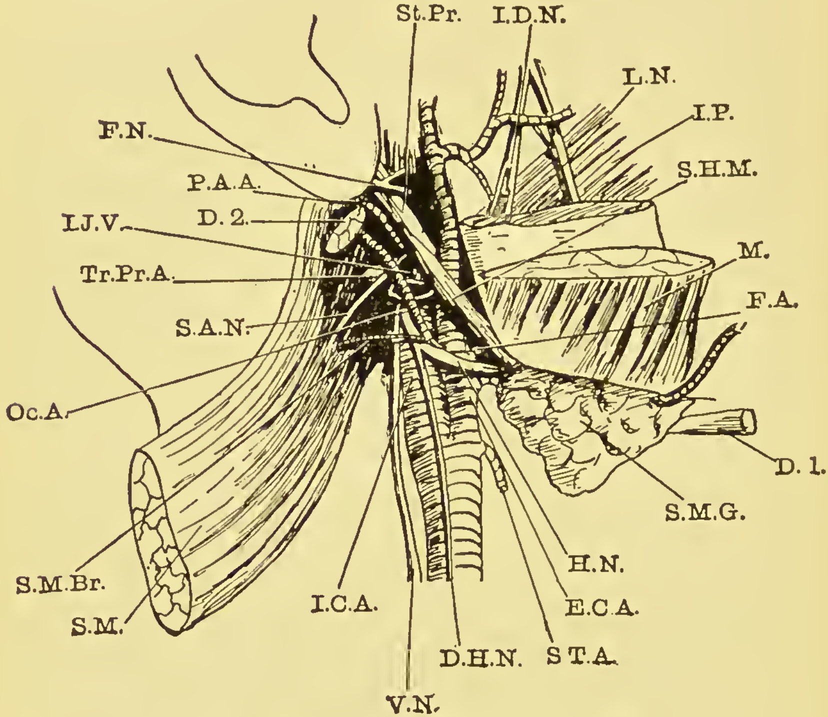


Fig. 86.—Course of the Occipital Artery.

St.Pr. Styloid Process. *I.D.N.* Inferior Dental Nerve. *L.N.* Lingual Nerve. *I.P.* Internal Pterygoid. *S.H.M.* Stylo-hyoid Muscle. *M.* Masseter. *F.A.* Facial Artery. D. 1. Anterior Belly of Digastric. *D.* 2. Posterior Belly of Digastric. *S.M.G.* Submaxillary Gland. *H.N.* Hypoglossal Nerve. *E.C.A.* External Carotid Artery. *S.T.A.* Superior Thyroid Artery. *D.H.N.* Descendens Hypoglossi Nerve. *V.N.* Vagus Nerve. *I.C.A.* Internal Carotid Artery. *S.M.* Sterno-mastoid. *S.M.Br.* Sterno-mastoid Branch of Occipital Artery. *Oc.A.* Occipital Artery. *S.A.N.* Spinal Accessory Nerve. *Tr.Pr.A.* Tranverse Process of Atlas. *I.J.V.* Internal Jugular Vein. *P.A.A.* Posterior Auricular Artery. *F.N.* Facial Nerve.

lying deep to the artery. The relation here is arranged on the same plan as that of the phrenic nerve with the transversalis colli and suprascapular arteries in front of the

scalenus anticus. In both cases the nerve is deep, and it

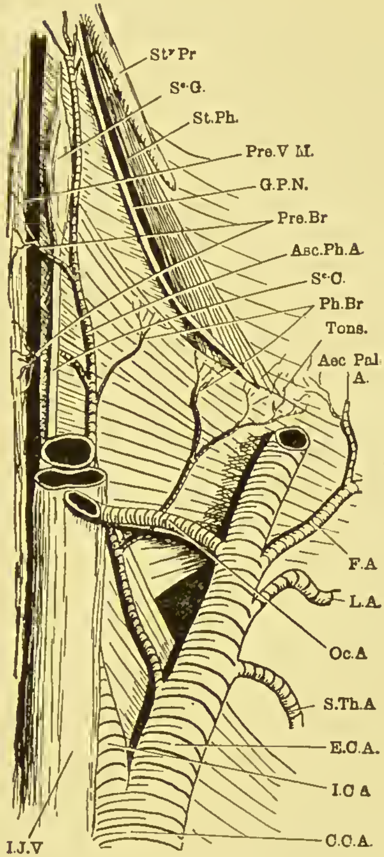


FIG. 87.—COURSE OF THE RIGHT ASCENDING PHARYNGEAL ARTERY.

St^v.P^r. Styloid Process. *S^c.G.* Superior Cervical Ganglion of Sympathetic. *St.Ph.* Stylo-pharyngeus Muscle. *Pre.V.M.* Prevertebral Muscles. *G.P.N.* Glosso-pharyngeal Nerve. *Pre.Br.* Prevertebral Branches of *Asc.Ph.A.* Ascending Pharyngeal Artery. *S^c.C.* Sympathetic Cord. *Ph.Br.* Pharyngeal Branches. *Tons.* Tonsillar Anastomosis. *Asc.Pal.A.* Ascending Palatine Branch of *F.A.* Facial Artery. *L.A.* Lingual Artery. *Oc.A.* Occipital Artery. *S.Th.A.* Superior Thyroid Artery. *E.C.A.* External Carotid Artery (drawn forward). *I.C.A.* Internal Carotid Artery. *C.C.A.* Common Carotid Artery. *I.J.V.* Internal Jugular Vein.

seems probable that the arteries would be liable to com-

pression if they lay between the muscle and the nerve. In the greater number of cases, however, the spinal accessory nerve lies on a level with or below the transverse process of the atlas (see Fig. 86).

Very often, too, the nerve passes deep to the internal jugular vein instead of superficial, and more rarely may lie deep to the sterno-mastoid instead of piercing that muscle, but in any case there is always more of the sterno-mastoid superficial to the nerve than there is deep to it.

Now look for the *Ascending pharyngeal artery* [A. pharyngea ascendens] rising from the deep surface of the external carotid, usually near its beginning. At first it lies between the external and internal carotids, but, as it ascends, passes in front of the latter vessel to reach the wall of the pharynx, which is here formed by the superior constrictor muscle (see Fig. 87).

It is a slender artery lying close to the prevertebral muscles (rectus capitis anticus major and longus colli). As it runs upwards it gives off branches to the pharynx, some of which join in the tonsillar anastomosis as well as to the prevertebral muscles, and it ends at the base of the skull by giving off posterior meningeal branches which pass through the jugular and sometimes the anterior condylar foramina. Notice that it passes deep to the stylo-glossus and stylo-pharyngeus muscles and to the glosso-pharyngeal nerve.

The Internal Carotid Artery [A. carotis interna].—Just after the bifurcation of the common carotid the internal carotid often bulges outwards a little, so that at first it may be really more superficial than the external carotid, though it is always behind the latter vessel. It very soon, however, occupies a deeper plane and runs up on the outer side of the pharyngeal wall to reach the carotid canal, which, as has been noticed, is directly in front of the jugular foramen.

Near the angle of the jaw the internal carotid lies about a quarter of an inch outside and behind the tonsil, and although it is not really so near that gland as is the facial

artery it is more liable to injury in opening abscesses of the tonsil, because it lies in the direct line of the knife-thrust if this goes too deep.

The structures which lie between the external and internal carotid arteries should now be revised; they are—

Bones.—The styloid process near its tip.

Muscles.—The stylo-pharyngeus and, if the styloid process is short, the stylo-glossus.

Fibrous Structures.—The stylo-hyoid ligament if the styloid process is short.

Arteries.—The ascending pharyngeal.

Veins.—Descending pharyngeal veins draining the pharyngeal plexus into the internal jugular.

Nerves.—The glosso-pharyngeal and pharyngeal branches of the vagus.

Glandular Structures.—Parotid gland and carotid body.

All these have been noticed already, except the last, which is a small mass of tissue, probably belonging to the sympathetic system, lying in the fork between the origins of the external and internal carotids.

It is best found by twisting these two arteries round, but can seldom be satisfactorily demonstrated by macroscopical methods.

In addition to the structures named as lying between the internal and external carotid arteries, it must be remembered that the internal jugular vein and vagus nerve are external relations of the former, that the superior laryngeal nerve is internal, and that the rectus capitis anticus major and superior cervical ganglion of the sympathetic are posterior.

As a rule, no branches of any importance are given off by the internal carotid artery in the neck.

DISSECTION OF THE PHARYNX

In order to get a good view of the outside of the pharynx it is necessary to separate it from the vertebral column. To

do this satisfactorily the skull should be divided, but in such a way that the subsequent dissection of the ear is not interfered with.

By the time the dissection has reached this stage the dissectors of the thorax will probably have got on so far that it will not inconvenience them if the head and neck are removed between the first and second thoracic vertebræ, thus retaining the first rib and its attachments. It is not often that they can fairly be asked to allow more than this to go, but, if for any reason it is possible to do so, it is better to divide the spinal column below the third thoracic vertebra, thus preserving the whole of the longus colli muscle.

Cut through the trachea and œsophagus and pull them forward away from the vertebræ; the knife need hardly be used in doing this, because the cellular tissue behind the œsophagus and pharynx and in front of the prevertebral muscles is very loose and woolly, and forms a lymph space quite comparable to the subaponeurotic one already noticed on the scalp (see p. 54). On account of its laxity it will obviously form a path of least resistance for blood or pus, while, owing to the movement of the pharynx and œsophagus, these fluids will be distributed along its course.

Turn the head upside down and separate the pharynx from the vertebral column as far as the base of the skull. On comparing the dissection with a dried skull it will be seen that posteriorly the pharynx is attached to the pharyngeal tubercle of the basioccipital bone, and it is between this and the insertion of the rectus capitis anticus major that the occipital bone must be chiselled through (see Fig. 88).

Take a broad chisel and place its edge transversely against the skull just behind the attachment of the pharynx. A sharp blow with the mallet, the head being upside down on the table, is very likely to lead to a fracture of the base of the skull through the two carotid canals and glenoid

cavities, but this section, although it is interesting, is not so instructive as one which passes behind the jugular foramen, styloid and mastoid processes.

To avoid a fracture therefore support the interior of the

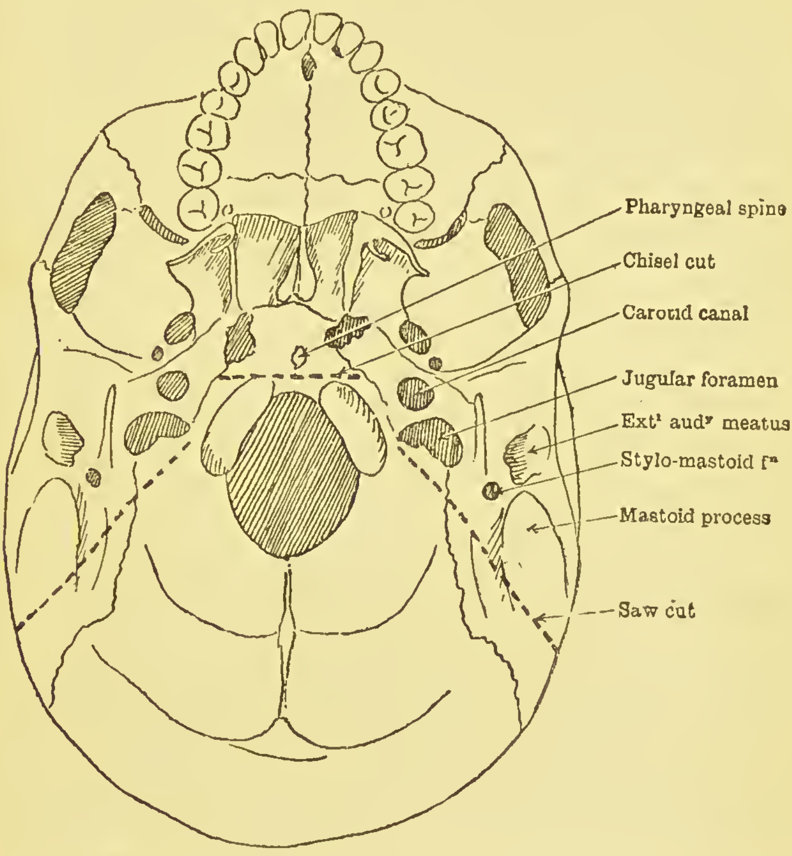


Fig. 88.—Diagram of Incisions in Skull preparatory to dissecting the Pharynx.

skull against the angle of a wooden block when chiselling through it. Now make a saw-cut on each side from a little behind the mastoid process to just internal to the jugular foramen, whence the internal jugular vein is emerging, trying, as far as possible, to avoid injury to the transverse process of the atlas. A few taps with the chisel and mallet

between these three cuts will separate the anterior from the posterior piece of the skull.

The hypoglossal nerve must be divided external to the anterior condylar foramen if the chisel has not already divided it, while the common carotid arteries should be cut about the level of the cricoid cartilage. The dissector has already been advised to cut the internal jugular vein.

Now wrap up and put away the posterior fragment, and fill the pharynx in the anterior one with tow or cotton wool soaked in spirit. This may be done from the mouth, but if there is any difficulty make a small vertical incision in the mid line behind to be sewn up when the packing is done.

It should be realised that this proceeding, though it makes the pharyngeal walls more easy to study, quite alters the appearance and relations of the natural pharynx, the lower part of which is a transverse slit with anterior and posterior walls and lateral borders.

The pharynx, when padded out, is now seen to be a muscular tube, the walls of which are formed by the three constrictors fitting into and overlapping one another like three flower-pots.

The *superior constrictor* rises from the lower part of the internal pterygoid plate, and from the pterygo-mandibular ligament. If the lower jaw had not been cut away it would also be found rising from the mylo-hyoid ridge opposite the last molar tooth (see Fig. 89). Where it is rising from the ligament its fibres are almost continuous with those of the buccinator, which are running forward from nearly the same place.

In cleaning the surface of the muscle the loose cellular tissue which covers it—and, if the pharynx had not been artificially distended, would be largely behind it—will be found to have collapsed into an artificial plane known as the *bucco-pharyngeal membrane.* In this cellular tissue lies the *pharyngeal plexus of veins*, continuous anteriorly with the

pterygoid plexus, and draining into the internal jugular by one or two *descending pharyngeal veins* (see Fig. 91, p. 185).

Here, too, lies the pharyngeal plexus of nerves formed by the pharyngeal branches of the glosso-pharyngeal, vagus

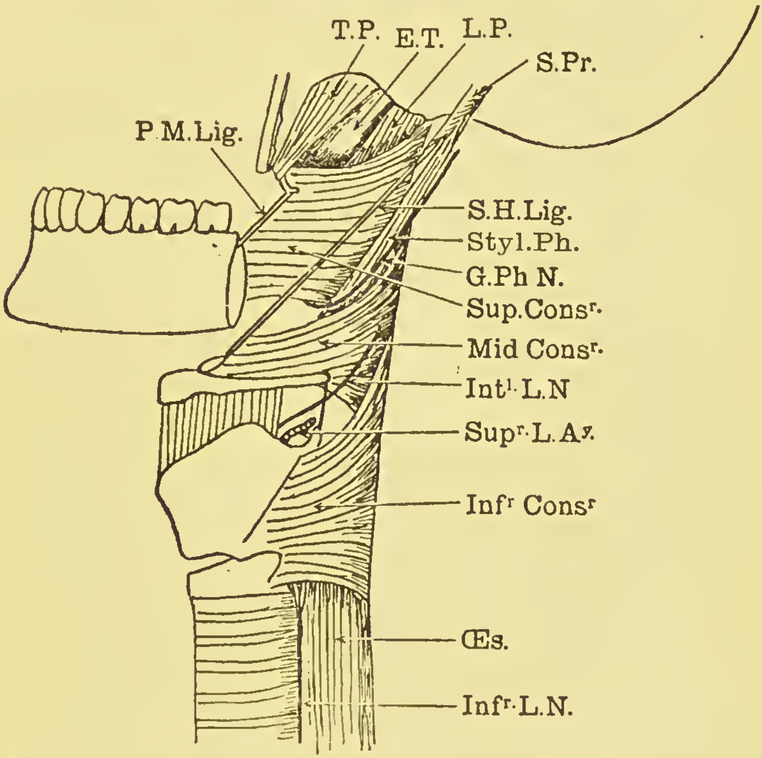


FIG. 89.—DIAGRAM OF THE CONSTRICTORS OF THE PHARYNX.

P.M.Lig. Pterygo-mandibular Ligament. *T.P.* Tensor Palati Muscle. *E.T.* Eustachian Tube. *L.P.* Levator Palati Muscle. *S.Pr.* Styloid Process. *S.H.Lig.* Stylo-hyoid Ligament. *Styl.Ph.* Stylo-pharyngeus Muscle. *G.Ph.N.* Glosso-pharyngeal Nerve. *Sup., Mid., and Inf. Cons^r.* Superior, Middle, and Inferior Constrictors. *Int^l.L.N.* Internal Laryngeal Nerve. *Sup^r.L.A^y.* Superior Laryngeal Artery. *Œs.* Œsophagus. *Inf.L.N.* Inferior Laryngeal Nerve.

and superior cervical ganglion of the sympathetic, all of which should be looked for again.

The upper fibres of the superior constrictor sweep backwards and upwards, describing a crescentic curve, to be

inserted into the pharyngeal tubercle of the basioccipital bone, while the lower ones end behind in the posterior median raphe (see Fig. 89).

The *middle constrictor* has already been seen arising from the two cornua of the hyoid bone as well as from the stylo-hyoid ligament (see p. 145).

Its upper fibres have the same upward and backward curve as those of the superior constrictor, and usually reach the pharyngeal tubercle. They hide the lower part of the upper constrictor.

The *inferior constrictor* rises from the outer surface of the thyroid and slightly from the cricoid cartilage, but its exact attachment will be seen better when these parts are examined. Its upper fibres run up to within two inches of the pharyngeal tubercle, while its lower ones turn a little down to blend with the œsophagus. Between these points its insertion, like that of the other two constrictors, is into the posterior median raphe. In the region of the inferior constrictor the calibre of the pharynx diminishes rapidly to that of the œsophagus.

Now measure the pharynx from the base of the skull to the level of the cricoid cartilage, where it ends. It will be found to be about five inches.

Above the superior constrictor, between it and the skull, is a space known as the *sinus of Morgagni*, through which pass the Eustachian tube, the levator palati muscle, and the ascending palatine branch of the facial artery. These are embedded in rather dense cellular tissue, which extends for some distance down on the deep surface of the superior constrictor, and is known as the *pharyngeal aponeurosis*. The *pterygo-mandibular ligament* is a thickening of this.

Notice that the sinus of Morgagni lies just internal to the exit of the fifth nerve from the foramen ovale, and therefore also close to the otic ganglion.

The *stylo-pharyngeus muscle* may now be followed down from the posterior and deep surface of the styloid process,

usually near its root, to the interval between the superior and middle constrictors. To see its insertion into the pos-

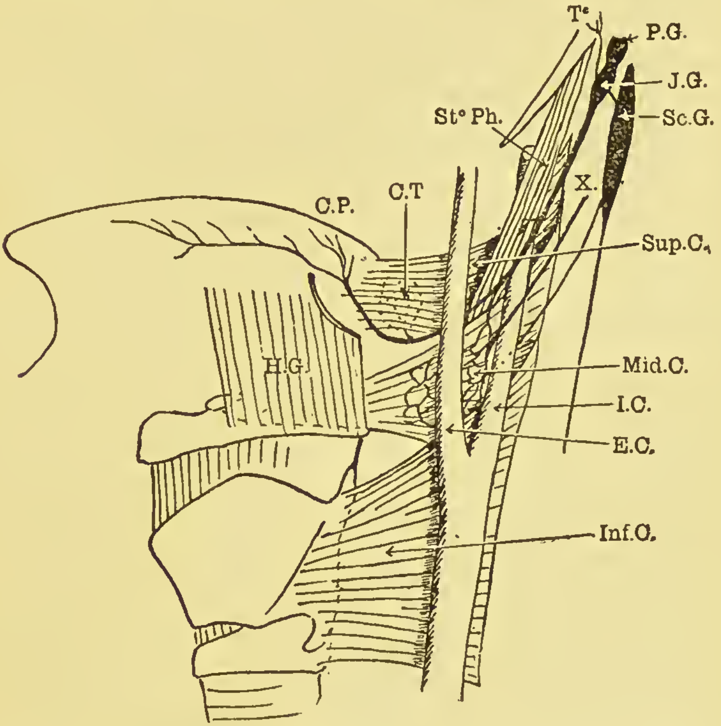


FIG. 90.—DISTRIBUTION OF THE GLOSSO-PHARYNGEAL NERVE.

P.G. Petrous Ganglion. *J.G.* Jugular Ganglion. *Sc.G.* Superior Cervical Ganglion of the Sympathetic. *X.* Pharyngeal Branch of Vagus. *Sup.C.* Superior Constrictor. *Mid.C.* Middle Constrictor with Pharyngeal Nerve Plexus upon it. *I.C.* Internal Carotid Artery. *E.C.* External Carotid Artery. *Inf.C.* Inferior Constrictor. *Tc.* Tympanic or Jacobson's Nerve. *St°.Ph.* Stylo-pharyngeus Muscle. *C.T.* Circulus Tonsillaris. *C.P.* Site of Circumvallate Papillæ. *H.G.* Hyo-glossus Muscle.

terior border of the thyroid cartilage the middle and inferior constrictors must be divided.

The *glosso-pharyngeal nerve* also passes between the upper and middle constrictors after it has wound round the posterior border of the stylo-pharyngeus.

Between the middle and inferior constrictors the internal laryngeal branch of the superior laryngeal nerve and the superior laryngeal artery pass on their way to the larynx, while below the inferior constrictor the recurrent laryngeal nerve is seen running up, giving a few twigs to that muscle, and being accompanied by the inferior laryngeal branches of the inferior thyroid artery (see Fig. 89).

Now make a median vertical incision right down the posterior median raphe of the pharynx, from the skull to the level of the cricoid cartilage; remove the packing and wash out the cavity.

On turning aside the flaps the anterior wall of the interior of the pharynx is seen. In the upper part this is wanting, since here the *naso-pharynx*, as the cavity above the soft palate is called, is continuous with the nasal fossæ through the *posterior nares* or *choanæ*, and the back of the septum, formed by the vomer covered by mucous membrane, is seen in the distance.

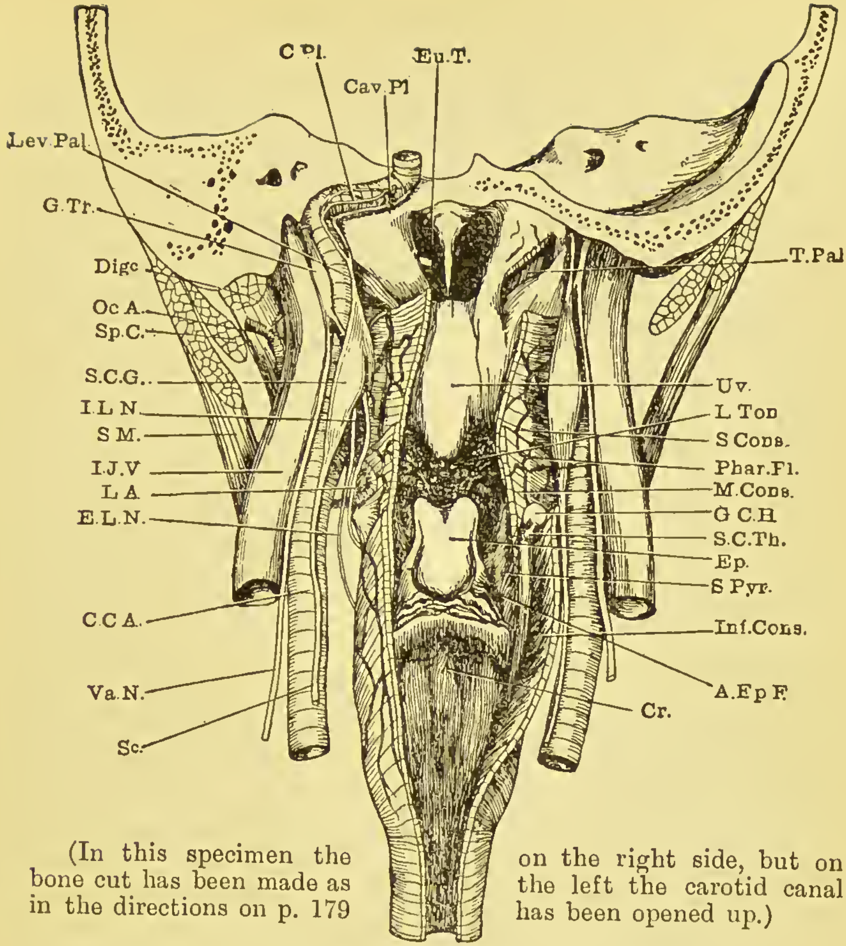
Below this is the soft palate hanging down from the horizontal processes of the palate bones, and lying against the posterior surface of the tongue.

In the mid line the soft palate is prolonged down into the conical *uvula*.

Below the soft palate is the *oral pharynx*, the anterior wall of which is formed by the posterior surface of the tongue.

Lift up the uvula and look for the *foramen cæcum*, a small pit into which a seeker may be pushed for an eighth to a quarter of an inch. This is in the mid line of the tongue, at the junction of its superior and posterior surfaces, and marks the upper end of the thyro-glossal duct of the fœtus from which the isthmus and part of the lateral lobes of the thyroid gland were developed.

On each side of the foramen cæcum a slight groove runs forwards and outwards, known as the *sulcus terminalis*, indicating the separation between the pharyngeal and oral parts of the tongue, which are developed separately.



(In this specimen the bone cut has been made as in the directions on p. 179 on the right side, but on the left the carotid canal has been opened up.)

FIG. 91.—PHARYNX VIEWED FROM BEHIND.

T.Pal. Tensor Palati through an incision in the Mucous Membrane. *Uv.* Uvula. *L.Ton.* Lingual Tonsil. *S.Cons.* Superior Constrictor. *Phar.Pl.* Pharyngeal Plexus of Veins. *M.Cons.* Middle Constrictor. *G.C.H.* Tip of Great Cornu of Hyoid Bone. *S.C.Th.* Superior Cornu of Thyroid Cartilage. *Ep.* Epiglottis. *S.Pyr.* Sinus Pyriformis. *Inf.Cons.* Inferior Constrictor. *A.Ep.F.* Ary-epiglottic fold. *Cr.* Position of Cricoid Cartilage. *Sc.* Sympathetic Cord. *Va.N.* Vagus Nerve. *C.C.A.* Common Carotid Artery. *E.L.N.* External Laryngeal Nerve. *L.A.* Lingual Artery. *I.J.V.* Internal Jugular Vein. *S.M.* Sterno-mastoid. *I.L.N.* Internal Laryngeal Nerve. *S.C.G.* Superior Cervical Ganglion. *Sp.C.* Splenius Capitis. *Oc.A.* Occipital Artery. *Dig*[c]. Digastric. *G.Tr.* Ganglion of Trunk of Vagus. *Lev.Pal.* Levator Palati. *C.Pl.* Carotid Plexus of Sympathetic. *Cav.Pl.* Branch to the Cavernous Plexus of Sympathetic. *Eu.T.* Rod placed in Eustachian Tube.

The *posterior surface of the tongue* consists of a mass of low tubercular swellings, caused by masses of lymphoid tissue deep to the mucous membrane. Most of these have little dark specks at their centres, which are the openings of small mucous crypts, and into these a fine seeker may be pushed for a little distance. This mass of lymphoid tissue on the back of the tongue is sometimes known as the *lingual tonsil.*

Lying against the posterior surface of the tongue, and nearly reaching the uvula, is the epiglottis, a leaf-shaped cartilage, which will be examined later with the larynx.

In swallowing, the larynx is drawn up to the epiglottis, and the tongue comes back, but the epiglottis is curved in such a way that the food passes over its posterior surface near the tip, and it is only its lower part which actually forms a lid to the larynx.

Press the tongue forward, draw the epiglottis backward, and notice the *glosso-epiglottic fold* of mucous membrane, which is median, and passes from the epiglottis to the tongue.

There are also two lateral folds which pass forward and outward from the epiglottis to the pharyngeal wall close to the tonsil, and are known as *pharyngo-epiglottic folds.*

Between these three folds are two shallow pouches known as the *Valleculæ*, into which the point of an instrument may be passed by an inexpert operator when trying to reach the larynx, and in which small foreign bodies, like fish bones, occasionally become lodged.

From the lateral margins of the epiglottis the *aryteno-epiglottidean folds* [plicæ ary-epiglotticæ] of mucous membrane pass backwards and downwards to the arytenoid cartilages, enclosing between them the upper opening of the larynx [aditus laryngis] (see Fig. 91).

Near its posterior end each fold has an oval swelling, caused by lymphoid tissue, in which is embedded the little

cuneiform cartilage. This may sometimes be felt between the finger and thumb on deep pressure.

The outline of the arytenoid cartilages is quite obscured by the muscle and mucous membrane which covers them, but at their upper ends, where the aryteno-epiglottidean folds join them, the little cornicula laryngis project backward and may easily be felt.

At the side of each aryteno-epiglottidean fold, between it and the top of the thyroid cartilage, is the *sinus pyriformis* [recessus piriformis], the narrow end or stalk of which points downwards. This is another place into which laryngeal instruments may be passed by the beginner in trying to reach the vocal cords, and it is also a favourite site for the lodgment of foreign bodies which have been inhaled.

Deep to the mucous membrane in the floor of this sinus the internal laryngeal nerve lies, a fact which may easily be demonstrated by pulling on the nerve externally while the tip of the forefinger is placed in the sinus pyriformis.

Below the arytenoid cartilages the signet part of the cricoid ring forms the anterior wall of the pharynx, but it is covered by muscles and, of course, by mucous membrane.

At the lower level of the cricoid the pharynx narrows into the œsophagus.

After the anterior wall of the pharynx has been studied, the head should be divided by a sagittal section, a little to one side of the mid line. As the object of this is to facilitate the study of the nasal cavity as well as of the pharynx, it is well to notice to which side the septum of the nose bulges, since it is hardly ever quite median, and to make the section correspond to the concave side.

A good deep tenon saw should be used, and if one is available in which the back can be lifted up when the saw is deeply engaged, a true section will be more easily made. Anatomical saws should have small teeth, and if this is the case very little damage will be done to the soft parts. Let the cut pass just on one side of the crista galli, and run

downwards through the inner part of the socket of the central incisor tooth, which should be drawn before the section is made. As soon as the saw is approaching the soft palate the latter should be divided with a knife as near the mid line as possible.

Now the side wall and roof of the pharynx may be thoroughly explored.

The most striking structure is the inner *opening of the Eustachian tube* [ostium pharyngeum tubæ], a large and somewhat triangular orifice, situated about half an inch below the roof of the pharynx, half an inch above the soft palate, half an inch behind the posterior end of the inferior turbinated bone, and half an inch in front of the posterior wall of the pharynx. Just behind the opening the cartilage forming the inner wall of the tube projects and forms an elevation in the mucous membrane, known as the *Eustachian cushion* [torus tubarius]. The dissector should pass a blowpipe, with the end slightly bent, through the nose, and notice how easily the Eustachian tube can be catheterised. A little behind and above the opening of the tube is the *lateral recess of the pharynx* [recessus pharyngeus].

In the roof of the pharynx a small recess, the *pharyngeal bursa*, should be looked for, though it is not always seen in dissecting-room subjects. It is easily demonstrable, however, in the fœtus or child.

Surrounding this bursa is a mass of lymphoid tissue known as the *pharyngeal tonsil*, which also extends some way down the posterior and lateral pharyngeal walls. Like the pharyngeal bursa, it is seen at its best in the child, and when chronically enlarged causes the condition known as "adenoids," from which so many children suffer.

Now look carefully at the section of the *Soft Palate* [velum palatinum], and noticethat it is covered by mucous membrane on both surfaces, which enclose between them muscular and glandular tissue. Anteriorly the glandular tissue predominates, but posteriorly the muscular is more plentiful.

Two muscles, the levator and tensor palati, run down to the soft palate from above on each side. Another two, the

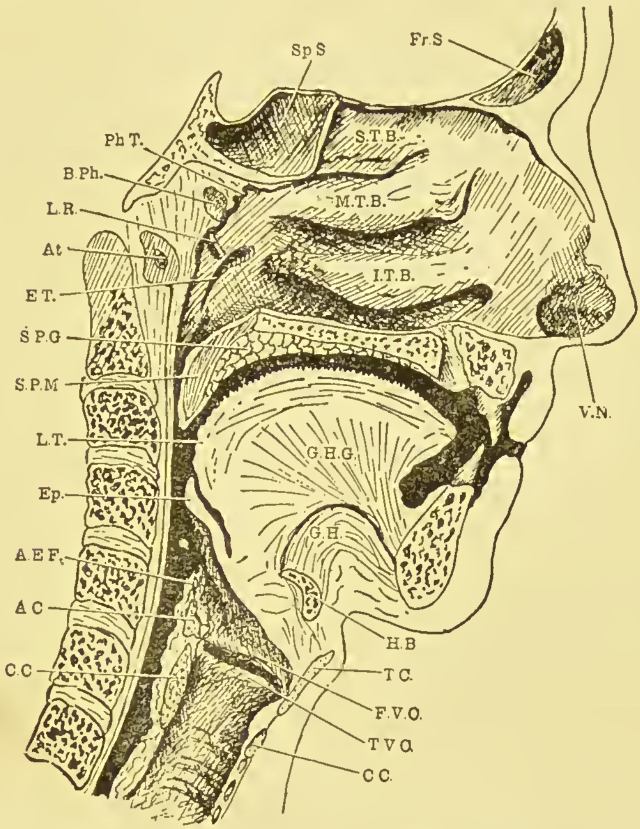


FIG. 92.—MEDIAL SECTION OF NOSE AND PHARYNX.

Fr.S. Frontal Sinus. *Sp.S.* Sphenoidal Sinus. *S.T.B., M.T.B., and I.T.B.* Superior, Middle, and Inferior Turbinated Bones. *Ph.T.* Pharyngeal Tonsil. *B.Ph.* Bursa Pharyngea. *L.R.* Rod passing into Lateral Recess. *E.T.* Eustachian Tube. *S.P.G.* Glandular Tissue of Soft Palate. *S.P.M.* Muscle of Soft Palate. *L.T.* Lingual Tonsil. *Ep.* Epiglottis. *A.E.F.* Ary-epiglottic Folds. *A.C.* Arytenoid Cartilage. *C.C.* Cricoid Cartilage. *T.V.C.* True Vocal Cord. *F.V.C.* False Vocal Cord. *T.C.* Thyroid Cartilage. *H.B.* Hyoid Bone. *G.H.* Genio-hyoid Muscle. *G.H.G.* Genio-hyo-glossus Muscle. *V.N.* Vestibule of Nose.

palato-glossus and palato-pharyngeus, run up to it from below, while a fifth muscle, the *Azygos uvulæ*, is intrinsic

and runs back from the posterior nasal spine into the uvula, lying so close to its fellow of the opposite side that it was at one time looked upon as a single medial muscle, and so acquired its name. It is this muscle which is seen in the sagittal section already made.

Put a hook through the base of the uvula and draw the soft palate downwards, making it as tense as possible. Dissect the mucous membrane off its upper surface, and continue

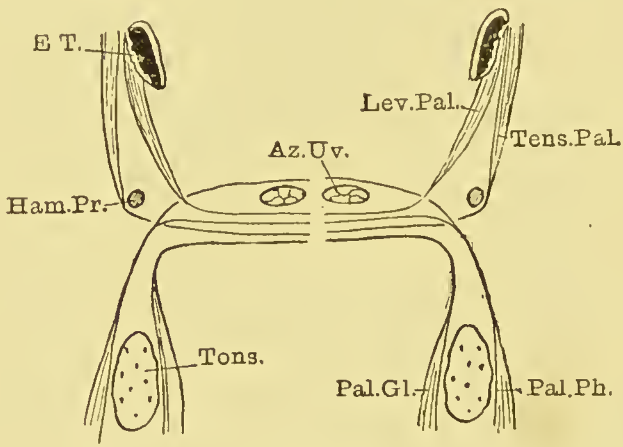


FIG. 93.—DIAGRAM OF THE MUSCLES ACTING UPON THE SOFT PALATE.

E.T. Eustachian Tube. *Ham.Pr.* Hamular Process. *Tons.* Tonsil. *Az.Uv.* Azygos Uvulæ. *Lev.Pal.* Levator Palati. *Tens.Pal.* Tensor Palati. *Pal.Gl.* Palato-glossus. *Pal.Ph.* Palato-pharyngeus.

the dissection until the whole of the side of the naso-pharynx has been cleared of mucous membrane. In doing this the cartilaginous part of the *Eustachian tube* is laid bare, and it will be seen how rapidly the tube enlarges as it approaches the pharynx. Notice, too, how much better the cartilage is developed on the inner than on the outer side. It will be realised that the sinus of Morgagni is now being approached from the inner side, and the three structures which pass through from the outer side must be looked for on this

aspect. These three structures are the Eustachian tube, the levator palati, and the ascending palatine artery.

The *Levator palati* [M. levator veli palatini] should be looked for just below the Eustachian tube and followed up to the apex of the petrous bone, where it rises. It also rises a little from the floor of the tube, which it is supposed to open, since some people are able to blow up their Eustachian tubes during the act of swallowing. It can be followed right down to the soft palate, of which it forms the most superficial layer, as seen from above, except posteriorly, where the upper layer of the palato-pharyngeus conceals a little of it, and near the middle line, where the azygos uvulæ lies.

The *ascending palatine artery* is seen ramifying on the soft palate if the injection is good.

The *Tensor palati* [M. tensor veli palatini] should be sought where it has turned round the hamular process. Here it is a rather broad aponeurotic sheet which can be followed into the soft palate, but this should only be done on one side, because the levator palati, azygos uvulæ, and palato-pharyngeus are above it and must be reflected in order to see it. Trace the anterior fibres into the posterior edge of the palatine process of the palate bone, and the rest of the aponeurosis to the median raphe. The origin and upper fleshy part of the tensor palati lie on the outer side of the Eustachian tube, the muscle rises from the scaphoid fossa and great wing of the sphenoid as far back as the spine, and is a plate compressed from side to side, with its posterior border running downwards and forwards.

On one side it will be a useful exercise to remove the cartilaginous part of the Eustachian tube, and to pick up the nerve to the internal pterygoid, already exposed in the pterygoid dissection (p. 139).

Perhaps the *otic ganglion* may be found close to it and a little way below the foramen ovale. With care it is sometimes possible to trace a twig from the ganglion to the tensor

palati muscle, though at this stage of the dissection the part is not at its best for delicate work.

Below the soft palate is the oral pharynx, and in the lateral wall of this two folds are seen on either side running down from the soft palate; they are known as the *pillars of the fauces*, the anterior one containing the palato-glossus [arcus glosso-palatinus], and the posterior the palato-pharyngeus [arcus pharyngo-palatinus].

Between these lies the *fossa of the tonsil*, in which the *tonsil* is seen—an oval body, about three-quarters of an inch long, dotted with twelve to fifteen mucous crypts which sink into the lymphoid tissue of which the organ is formed. In old people the lymphoid tissue here, as in other parts of the body, shrinks, and the tonsils are not nearly as large as they are in youth.

If a needle is thrust outwards through the tonsil, it will pierce the superior constrictor in front of both carotid arteries, transfix or come into close relation with the facial artery, and appear on the surface about the angle of the jaw.

Just above the tonsil is the small triangular *supra-tonsillar recess*, which sometimes has a small valvular fold of mucous membrane covering it.

Dissect the mucous membrane off the anterior pillar of the fauces, and expose the *palato-glossus* muscle, which, as it is traced up to the soft palate, forms the lowest muscular layer of that structure; in the anterior pillar it is cylindrical, and when it reaches the tongue it turns inwards and becomes continuous with the lingualis transversus. Like all the other muscles of the soft palate, except the tensor palati, it is supplied by the pharyngeal plexus, deriving its fibres ultimately from the spinal accessory.

Before reflecting the mucous membrane from the posterior pillar of the fauces, notice that it is continuous with the pharyngo-epiglottic fold, and where the two join a small secondary tonsil may sometimes be seen in young subjects. When the mucous membrane is dissected off, the *palato-*

pharyngeus is exposed. This, on reaching the soft palate, divides into a small upper layer, which is the highest of all the muscles on the nasal surface of the velum, and a larger, deeper layer which lies below the levator palati and azygos uvulæ and above the tensor palati. Below the palato-pharyngeus joins the stylo-pharyngeus and has the same insertion (see Fig. 106). It is supplied by the pharyngeal plexus of nerves.

At this point it will be well to review the various layers of muscles met with in the soft palate; they are, from above downwards: (1) Palato-pharyngeus (superficial layer); (2) Azygos uvulæ; (3) Levator palati; (4) Palato-pharyngeus (lower main layer); (5) Tensor palati; (6) Palato-glossus.

In clearing off the mucous membrane from the oral surface of the soft palate, some small arteries will probably be seen coming through the accessory palatine canal or canals; they are branches of the descending palatine branch of the internal maxillary artery and help in the arterial supply of the tonsil.

The sensory nerves are very small, and accompany the arteries through the accessory palatine foramina; they are branches of Meckel's ganglion.

Nasal Fossæ

Each nasal cavity, when seen in a coronal section, is a right-angled triangle, the right angle being between the inner wall or septum and floor. As the section which has been made is a sagittal instead of a coronal one, just to one side of the septum, the outer wall will be seen on one side and the septum on the other.

On the septal wall is a very thick mucous membrane, which in its upper third belongs to the olfactory region, is non-ciliated, and has branches of the olfactory nerve distributed to it. In the lower two-thirds it is respiratory in function, ciliated, and very vascular. Running obliquely

downwards and forwards in this part is the *naso-palatine artery*, which runs from the spheno-palatine foramen to the anterior palatine canal. Here, as in all other parts of the dissection of the head, a skull should be at hand for reference. This artery is deep to the mucous membrane, but, if it is well injected, often shows through.

In the floor of the nasal fossa, just above the anterior palatine canal, a little depression in the mucous membrane should be looked for, while just above this, on the septal wall, a minute slit-like orifice is occasionally to be found in the adult, into which a seeker may be pushed upwards and backwards for a little distance. This slit, which represents the opening into the degenerated *organ of Jacobson*, can always be found in the fœtus.

Dissect the mucous membrane off the septum and look for the *naso-palatine artery* [A. spheno-palatina], and, accompanying it, the *naso-palatine nerve* [N. naso-palatinus], a branch of Meckel's ganglion. As this nerve comes through the spheno-palatine foramen, it should be picked up on the upper and back part of the septum. In dissecting the mucous membrane off the upper third of the septum, twigs of the olfactory nerves should be carefully looked for, while quite anteriorly the internal branch of the *nasal nerve* [N. ethmoidalis anterior] runs down and gives off sensory filaments as far as the anterior nares.

The deviation of the septum to one side, if it is present, should be carefully noted, because on a casual inspection of one nostril it may be mistaken for a tumour.

Now look at the other side of the section, which shows the outer wall and most of the roof and floor of the nasal fossa.

This shows the turbinated bones, each of which overhangs a space called a *meatus*.

Three turbinated bones are usually described, though in most specimens there are really four. The *inferior turbinated bone* [concha nasalis inferior] is the largest, and

stretches from a point one inch vertically above the neck of the incisor tooth to half an inch in front of the opening of

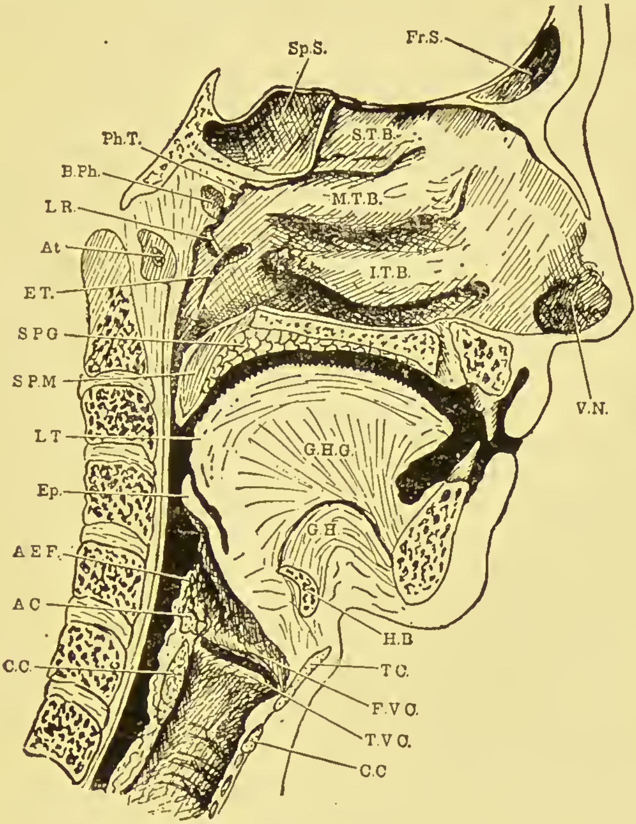


Fig. 94.—Medial Section of Nose and Pharynx.

Fr.S. Frontal Sinus. *Sp.S.* Sphenoidal Sinus. *S.T.B., M.T.B., and I.T.B.* Superior, Middle, and Inferior Turbinated Bones. *Ph.T.* Pharyngeal Tonsil. *B.Ph.* Bursa Pharyngea. *L.R.* Rod passing into Lateral Recess. *E.T.* Eustachian Tube. *S.P.G.* Glandular Tissue of Soft Palate. *S.P.M.* Muscle of Soft Palate. *L.T.* Lingual Tonsil. *Ep.* Epiglottis. *A.E.F.* Ary-epiglottic Folds. *A.C.* Arytenoid Cartilage. *C.C.* Cricoid Cartilage. *T.V.C.* True Vocal Cord. *F.V.C.* False Vocal Cord. *T.C.* Thyroid Cartilage. *H.B.* Hyoid Bone. *G.H.* Genio-hyoid Muscle. *G.H.G.* Genio-hyo-glossus Muscle. *V.N.* Vestibule of Nose.

the Eustachian tube. It is covered by very thick mucous membrane which is extremely vascular, and contains a well-

marked venous plexus. At its hinder end the mucous membrane often forms a little puckered knob, which in young people contains a mass of lymphoid tissue. It is the swelling of the mucous membrane covering the inferior turbinated bone which causes most of the discomfort in a "cold in the head."

Take the bone between the two blades of the forceps and lift it up until it breaks; it will still be held in position by the mucous membrane. This is to allow the opening of the nasal duct to be seen near the anterior attached margin. The orifice is usually valvular, and, if it is not seen at once, pass a seeker down from the lacrimal sac, already explored in the face (p. 115), and, on withdrawing the seeker, measure the length of the duct, which is about three-quarters of an inch.

The *middle turbinated bone* [concha nasalis media] is not so long as the inferior, and its anterior end is on a higher level than its posterior. Its mucous membrane resembles that covering the inferior turbinated, but is not so vascular.

Lift this bone up in the same way as that in which the inferior turbinated was lifted, and a globular swelling, the *ethmoidal bulla,* will be seen beneath it. Skirting the front and lower part of this bulla is a deep crescentic groove, the *hiatus semilunaris;* if a seeker is pushed upward along this, it will enter the frontal sinus through a tube known as the *infundibulum.* Below, the hiatus semilunaris has opening from it the maxillary antrum [sinus maxillaris]; and if some fluid is allowed to trickle down from the frontal sinus, it will usually fill the antrum before any escapes into the nose.

About the point where the tubular canal of the infundibulum becomes the open gutter of the hiatus semilunaris is the opening of the anterior ethmoidal cells, while on the summit of the bulla the middle ethmoidal cells open.

The superior turbinated bone [concha nasalis superior] overlies the superior meatus of the nose, and is still shorter and more oblique than the middle [with which it is continuous anteriorly]; it differs from the others in being

covered by olfactory mucous membrane, which is much less vascular than that in the respiratory tract, and has the olfactory nerves distributed to it. When the superior tur-

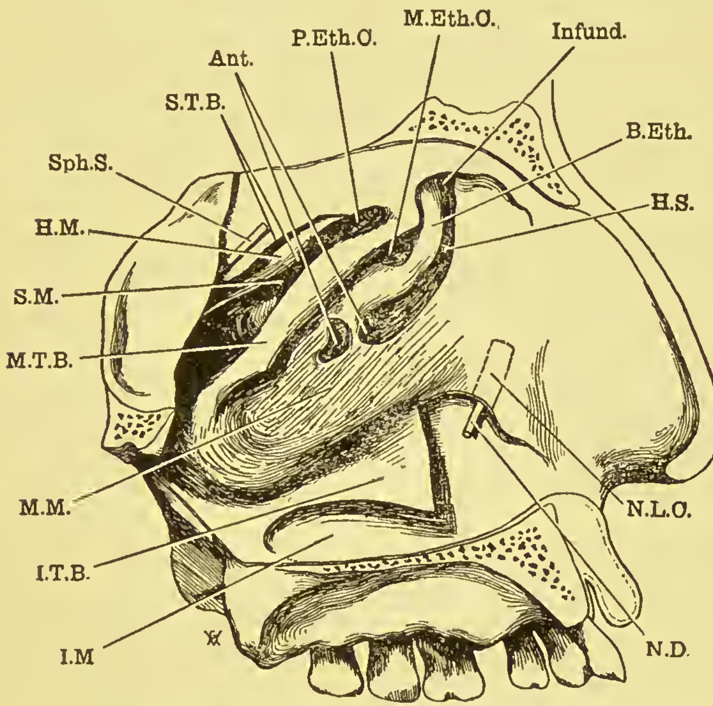


FIG. 95.—LATERAL WALL OF NASAL CAVITY WITH TURBINATED BONES CUT AWAY.

Sph.S. Rod in the opening of the Sphenoidal Sinus. *S.T.B.* Attachment of Superior Turbinated Bone bifurcating behind to enclose *H.M.* The Highest Meatus. *P.Eth.C.* Opening of Posterior Ethmoidal Cells. *S.M.* Superior Meatus. *M.T.B.* Attachment of Middle Turbinated Bone. *M.M.* Middle Meatus. *Infund.* Infundibulum. *H.S.* Hiatus Semilunaris. *Ant.* Openings of Antrum. *B.Eth.* Bulla Ethmoidalis. *M.Eth.C.* Opening of Middlo Ethmoidal Cells. *I.T.B.* Inferior Turbinated Bone. *I.M.* Inferior Meatus. *N.L.C.* Outline of Naso-lacrimal Canal. *N.D.* Rod in Nasal Duct.

binated bone is turned up the opening of the posterior ethmoidal cells will be seen beneath it (in the superior meatus).

A fourth or *highest turbinated bone* [concha nasalis

suprema] is generally present, and joins the superior turbinated in front, so that the two enclose between them a small triangular *highest meatus.* Into the posterior part of this is the opening of the sphenoidal sinus which has been opened by the saw-cut, and should be carefully explored.

Dissect away the mucous membrane from the outer wall of the nose, in doing which the turbinated bones will probably come away. Look out carefully for the anterior and external branches of the nasal nerve in the fore part, the former lying in the groove on the back of the nasal bone to reach at length the skin of the nose between the lower border of the nasal bone and the upper lateral cartilage of the nose.

At the hind end of the middle turbinated bone the *spheno-palatine foramen* will be exposed when the mucous membrane is stripped off, and through it the naso-palatine nerve and artery pass into the nose, and then run across the roof between the bone and mucous membrane to gain the septum.

One or two small nasal twigs from Meckel's ganglion, with accompanying vessels, may be found if very carefully looked for; they pass through the spheno-palatine foramen, and supply the mucous membrane of the lateral wall. In addition to these, small nasal twigs come from the descending palatine and posterior superior dental nerves, and supply the lower part of the outer wall of the fossa.

In clearing the mucous membrane away from the front part of the lateral wall of the nose, it will be noticed that when the inner surface of the ala is reached there is a space just inside the anterior nares, which is known as the *vestibule,* and is lined by skin bearing a few stiff hairs instead of by mucous membrane. This is the case for the septal as well as for the lateral wall.

The roof of the nose is very narrow, and has a middle horizontal part as well as anterior and posterior sloping parts.

The middle part, when the mucous membrane is partly dragged away, shows the cribriform plate of the ethmoid with the olfactory nerves coming through, though these are so soft that it is difficult to demonstrate them satisfactorily.

The nasal nerve should be traced up to the small foramen in front of the nasal slit, where it was left in the dissection of the cranial fossa (see Fig. 96). A few twigs of the anterior ethmoidal artery generally accompany it.

Put the two halves of the nasal cavity together and examine the *posterior nares* or *choanæ*, which have sometimes to be plugged for persistent bleeding from the nose. Each is about 1¼ inch high and ¾ inch broad.

Cut away the outer surface of the maxilla on one side, thus exposing the cavity of the antrum, and notice the relative positions of the nasal cavities, the ethmoidal cells, the orbit, and the maxillary antrum.

The *maxillary antrum* [sinus maxillaris] may now be explored, and the thinness of the plate of bone which separates it from the orbit tested by making a small perforation through it. Its floor is narrower than its roof, and the fangs of the first or second molar teeth often just project into it.

In the front of the antrum the infraorbital canal is seen projecting, with the canal for the anterior superior dental nerve running down from it. At the upper and inner angle the ethmoidal cells are only separated by a paper-like plate of bone from the antrum. Pass a seeker back along the roof of the nose, and notice how little space there is between the superior turbinated bone and the septum.

THE ORBIT

In dissecting the orbit it is advisable for the dissectors of the two sides to agree to work together. If this is done a very complete exposure of the cavity may be made on one

side, while on the other the bony attachments and relations of the intraorbital structures may be preserved.

On the left side chisel or trephine a hole through the orbital roof, and then with bone forceps, chisel and Hey's saw cut away piecemeal the whole of the orbital roof. As the antero-internal part is approached it will probably be noticed that the frontal air sinus extends into the roof of the orbit, so that a perforating wound from the orbit need not necessarily open up the anterior cranial fossa. The anterior part of the roof must be cut through with the tenon saw, and in doing this make the outer cut slope down and in, so as to give as much room as possible for the subsequent dissection. Posteriorly remove the roof of the anterior lacerated foramen, but not that of the optic foramen. It is not at all a bad plan to remove in addition the upper part of the outer wall, keeping, however, above the foramen for the temporo-malar nerve in the malar bone. The position of this should be identified in a dry skull. The periosteum or dura mater of the orbit is easily detachable from the bony roof, and should now be carefully removed within the limits of the dissection. The fat and cellular tissue of the orbit will thus be exposed, and the frontal and lacrimal nerves may be traced forwards in it from the first division of the fifth in the cavernous sinus.

The *Frontal nerve* runs forwards, and about the middle of the cavity divides into the *supraorbital* and *supratrochlear nerves.* The former often splits into an internal and external branch before it reaches the supraorbital notch or foramen, and is the outer of the two (see Fig. 96).

The *supratrochlear nerve* runs to the inner part of the roof of the orbital aperture, and earns its name from passing just above the trochlea or pulley of the superior oblique muscle. It is probable that this pulley will have been damaged in exposing the orbit, but its attachment may be found on the piece of bone removed, and it can be preserved on the other side. Just before the nerve leaves the orbit a

small *infratrochlear branch* is given off which joins a twig of the same name from the nasal nerve. The *Lacrimal nerve* is smaller than the frontal, and runs forwards through the anterior lacerated foramen, along the outer part of the roof

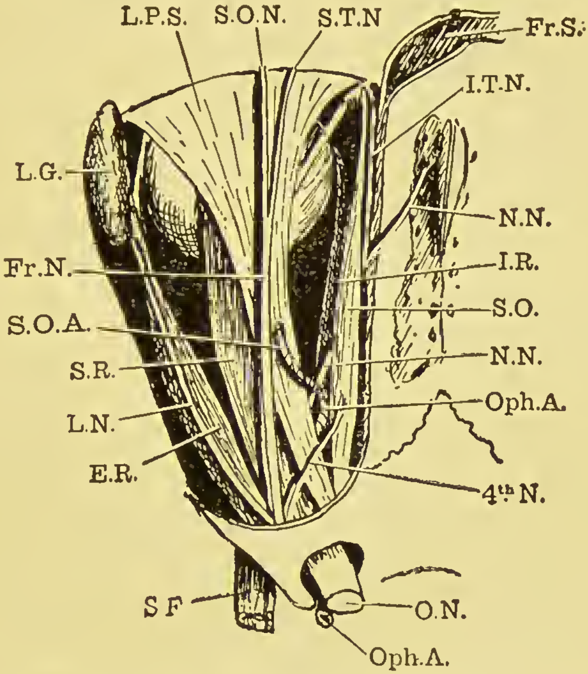


FIG. 96.—THE LEFT ORBIT FROM ABOVE.

L.P.S. Levator Palpebræ Superioris Muscle. *S.O.N.* Supraorbital Nerve. *S.T.N.* Supratrochlear Nerve. *Fr.S.* Frontal Sinus. *I.T.N.* Infratrochlear Nerve. *N.N.* Nasal Nerve. *I.R.* Internal Rectus. *S.O.* Superior Oblique. *Oph.A.* Ophthalmic Artery giving off its Supraorbital Branch. *4th N.* Fourth or Trochlear Nerve. *O.N.* Optic Nerve. *S.F.* Structures entering Orbit through the Sphenoidal Fissure. *E.R.* External Rectus. *L.N.* Lacrimal Nerve. *S.R.* Superior Rectus. *S.O.A.* Supraorbital Artery. *Fr.N.* Frontal Nerve. *L.G.* Lacrimal Gland drawn aside.

of the orbit, until it reaches the lacrimal gland, which it enters and supplies. After this a few twigs come out of the front of the gland to supply the outer part of the upper eyelid with sensation. In the outer part of the orbit a small twig of communication is received from the temporo-malar nerve.

The *Lacrimal gland* is about the size of a bean, and is usually completely surrounded by the orbital fat; the lacrimal nerve, however, leads to it. Clean it carefully, and notice that it consists of a larger upper and a smaller lower lobe. By gently drawing it up its minute ducts may be seen passing to the outer part of the upper fornix of the conjunctiva (see Fig. 98).

The *fourth nerve* (Trochlearis) will be found at the back of the orbit internal to the frontal, and may be traced forwards until it enters the upper (orbital) surface of the superior oblique muscle, which it does very soon.

These three nerves—lacrimal, frontal, and trochlearis—are the only ones which enter the orbit above the muscles, and they lie in the order named from without inwards.

The *levator palpebræ superioris muscle* rises above and internal to the optic foramen, and rapidly widens as it runs forwards to be inserted into the tarsal plate of the upper eyelid. Cut it across about its middle, and turn the hinder end backwards very gently to see its nerve supply, which comes from the oculo-motor (3rd) and pierces the superior rectus to reach it. The broad fascial sheet into which the anterior part expands is attached on each side to the anterior margins of the orbit, the external attachment going to a well-marked tubercle on the malar bone. A few fibres from its deep surface may be traced into the upper arch or fornix of the conjunctiva, while a few superficial ones lose themselves among the fibres of the orbicularis palpebrarum. The *superior rectus* rises just above the optic foramen, and runs forwards and outwards to the upper surface of the eyeball, where it is inserted into the sclerotic coat about one-third of an inch behind its junction with the cornea. A line drawn along the middle of the muscle passes internally to the vertical axis at the centre of the eyeball, and so the action of the superior rectus is to turn the eye up and in.

Cut the muscle and, after reflecting it, look for the superior division of the third nerve entering its deep (ocular) surface quite far back (see Fig. 99).

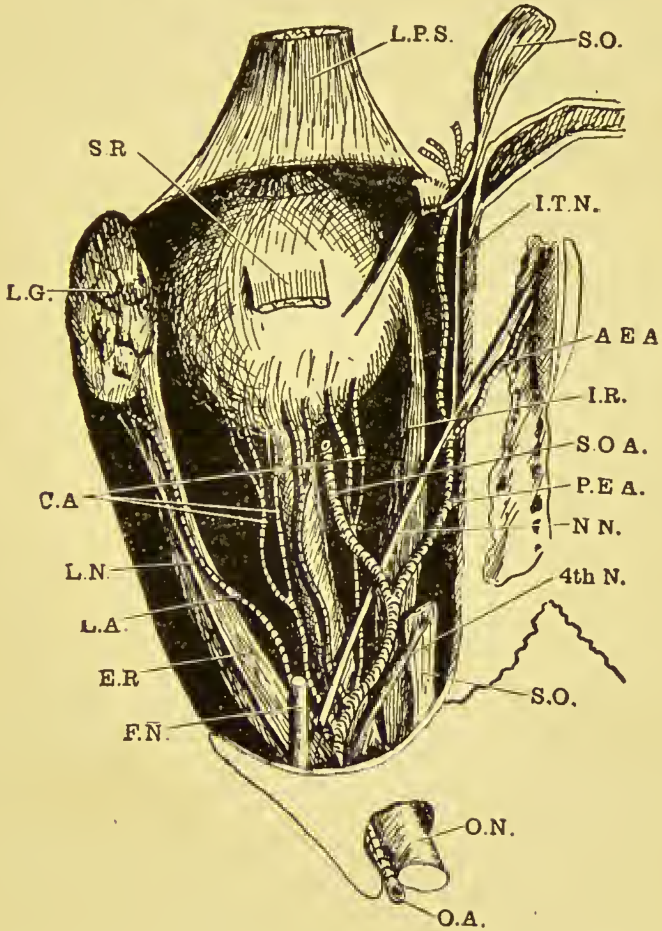


FIG. 97.—DEEPER DISSECTION OF THE LEFT ORBIT.

L.P.S. Levator Palpebræ Superioris reflected. *S.O.* Superior Oblique, cut and anterior part reflected. *I.T.N.* Infratrochlear Nerve. *A.E.A.* Anterior Ethmoidal Artery. *I.R.* Internal Rectus. *S.O.A.* Supraorbital Artery. *P.E.A.* Posterior Ethmoidal Artery. *N.N.* Nasal Nerve. *4th N.* Trochlear Nerve. *O.N.* Optic Nerve. *O.A.* Ophthalmic Artery. *F.N.* Frontal Nerve. *E.R.* External Rectus. *L.A.* Lacrimal Artery. *L.N.* Lacrimal Nerve. *C.A.* Ciliary Arteries. *L.G.* Lacrimal Gland. *S.R.* Superior Rectus.

At this stage it will be well to start the dissection of the right orbit, but instead of removing all the roof and much of the outer wall, as has been done on the left side, leave a narrow bridge of bone at the anterior orbital margin, and do not remove the roof of the anterior lacerated foramen. This orbit, although it will be harder to dissect than the other,

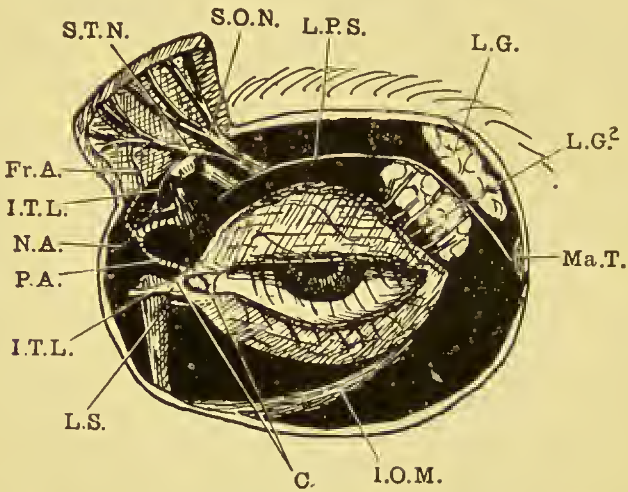


Fig. 98.—Dissection of Left Orbit from in front.

S.O.N. Supraorbital Nerve. *L.P.S.* Levator Palpebræ Superioris dividing the anterior part of the Lacrimal Gland (*L.G.* and *L.G²*.) into two parts. *Ma.T.* Malar Tubercle. *I.O.M.* Inferior Oblique Muscle. *C.* Canaliculi. *L.S.* Lacrimal Sac. *I.T.L.* Internal Tarsal Ligament. *P.A.* Internal Palpebral Artery. *N.A.* Nasal Artery. *I.T.L.* Infratrochlear Nerve Loop. *Fr.A.* Frontal Artery. *S.T.N.* Supratrochlear Nerve.

will keep the structures in their real positions much better. On the left side the *superior oblique* muscle has been seen where the fourth nerve enters it. It rises just internal to the origin of the levator palpebræ and runs forwards along the junction of the inner wall with the roof of the orbit. About the level of the front of the eyeball its tendon passes through the pulley, which, if it has been damaged on the left side, is intact on the right. It can usually be easily felt

through the eyelid in the living person, though this is more difficult in the formalin-hardened dead body.

After leaving the pulley the tendon turns backwards, outwards, and downwards to reach the outer and back part of the upper hemisphere of the eyeball, so that, when acting, it pulls the back of the eye upwards and inwards and makes the front look downwards and outwards.

It will be seen that the superior oblique passes below the superior rectus; indeed, its insertion could not have been seen unless the rectus had previously been cut.

It is not at all difficult to expose the pulley and a good deal of the tendon of the superior oblique from the front by dividing the palpebral ligament. This should be tried on the right side.

The *external rectus* [M. rectus lateralis] should be examined on the left orbit; it is remarkable for rising by two heads, one on each side of the anterior lacerated foramen. Between them the following structures pass from above downwards: (1) Upper division of oculo-motor nerve; (2) nasal branch of Fifth; (3) lower division of oculo-motor nerve; (4) Abducens (6th) nerve; (5) Ophthalmic vein (see Fig. 99).

As the muscle passes forwards to be inserted a little behind the sclero-corneal junction it should be examined very carefully, when it will be seen to be surrounded by a slight sheath of cellular tissue a little more delicate in texture than the surrounding fat-containing tissue. This sheath can be made into a quite definite sleeve by a little careful dissection, and on approaching the eyeball it will be seen that it too is enclosed in a similar casing of delicate cellular tissue, forming a lymph space.

This is known as the *Capsule of Tenon* [fascia bulbi], and may be traced forwards as far as the fornix of the conjunctiva and backwards as far as the optic nerve. From the outer and front part of the muscular sleeve on the external rectus some fairly dense fibres run outwards to the

orbital margin, forming the *external check ligament.* The cellular sheath and check ligament of the external rectus are typical of those of the other orbital muscles.

In addition to the check ligaments there are numerous

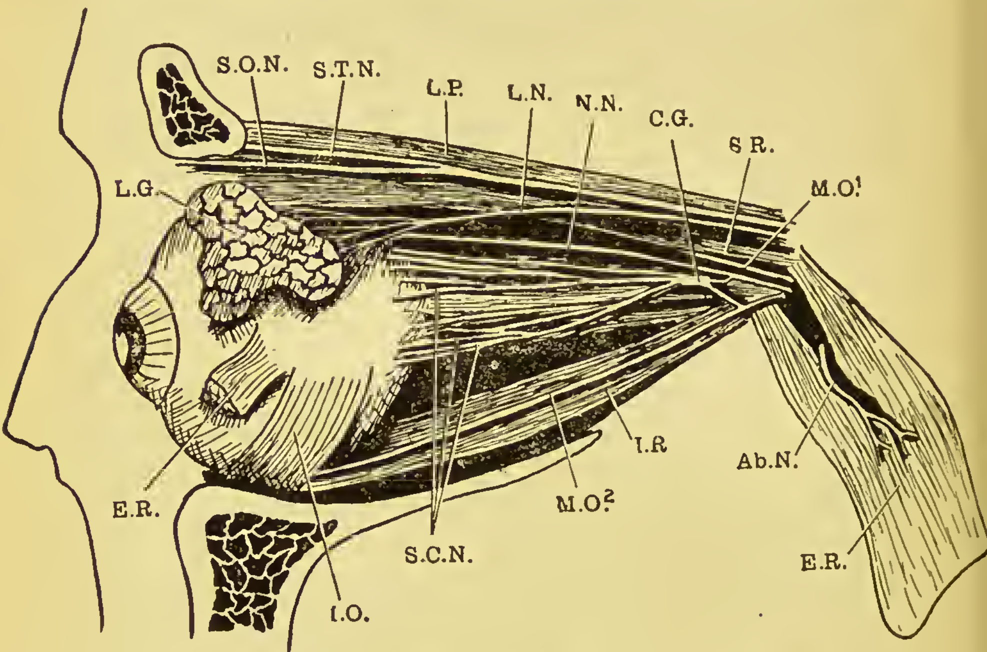


Fig. 99.—Left Orbit Exposed from Outer Side.

S.O.N. Supraorbital Nerve. *S.T.N.* Supratrochlear Nerve. *L.P.* Levator Palpebræ Superioris. *L.N.* Lacrimal Nerve. *N.N.* Nasal Nerve. *C.G.* Ciliary Ganglion. *S.R.* Superior Rectus. *M.O*[1]. Motor Oculi Nerve (upper division). *M.O*[2]. Motor Oculi Nerve (lower division). *Ab.N.* Abducens (sixth) Nerve. *E.R.* External Rectus (cut). *I.R.* Inferior Rectus. *S.C.N.* Short Ciliary Nerves. *I.O.* Inferior Oblique. *L.G.* Lacrimal Gland.

other condensations of areolar tissue in the orbit dividing the fat into compartments. Sections of frozen orbits have been made by the writer and the fat dissolved out, but no characteristic and definite arrangement of these septa has been found. They no doubt keep the semi-fluid fat in its place, and also localise for a time any pathological collection of fluid.

Now trace the *nasal nerve* on the right side from the anterior lacerated foramen forwards and inwards, above the optic nerve, until it reaches the inner wall of the orbit at the anterior ethmoidal canal. Here it gives off an *infra-trochlear* branch, which runs forwards to form a delicate loop with the supratrochlear already mentioned. From this loop the lacrimal sac is supplied. The roof of the ethmoidal canal may be carefully chiselled away, and then the continuity of the orbital and cranial stages of the nerve will be complete.

While the nasal nerve is still on the outer side of the optic nerve it gives off a small twig containing sensory and sympathetic fibres to the *ciliary ganglion*, a structure about the size of a pin's head, which is embedded in the fat between the optic nerve and the external rectus and not far in front of the anterior lacerated foramen (see Fig. 99, C.G.).

It is important to find this ganglion if possible, as most of the nerve supply of the eyeball passes through it. In addition to the sensory and sympathetic fibres just noticed from the nasal nerve, it receives a root containing motor fibres from the branch of the third nerve to the inferior oblique muscle.

From the front of it the *short ciliary nerves* will be seen running to pierce the sclerotic round the point at which the optic nerve enters. Where the nasal nerve is crossing the optic nerve, look for the two *long ciliary* branches which run forward to pierce the sclerotic with the short ciliaries.[1] If the ganglion and ciliary nerves are not found on the right side, they should be looked for on the left, though things have been more disturbed here.

The *ophthalmic artery* should now be traced. It was seen passing through the optic foramen below and outside the optic nerve, so that at the back of the orbit it should be looked for on the outer side of the nerve. It then crosses, usually above, the nerve and runs a tortuous course towards the posterior ethmoidal foramen in the inner wall of the

[1] Modern research makes it probable that some at least of the sympathetic fibres pass through the long ciliary nerves instead of through the ganglion.

orbit. It reaches this by passing between the superior oblique and internal rectus muscles, after which it runs forwards to the upper and inner part of the orbital aperture, where it divides into its three terminal branches, *nasal* [A. dorsalis nasi], *palpebral* [A. palpebralis medialis], and *frontal*, all of which have been studied in the dissection of the scalp and face (see Fig. 97).

While the artery is still on the outer side of the nerve it gives off a *lacrimal branch* for the gland and a *retinal branch* [A. centralis retinæ], which pierces the optic nerve below and externally about ¼ inch from the eyeball. As this artery is the only supply of the retina, any obstruction to it by embolism or pressure must cause blindness. Whilst crossing the optic nerve the ophthalmic artery gives off two *long* and five or six *short ciliary* branches, which pierce the sclerotic round the entry of the optic nerve; the latter supplying the choroid coat and ciliary processes, the former the iris. About the same place the *supraorbital artery* comes off and accompanies the frontal and supraorbital nerves to the forehead.

Muscular branches of great variability should be looked for, and are of special importance, because delicate twigs, known as the anterior ciliaries, run from them along the tendons of the muscles to the front of the eyeball; here, after giving off conjunctival twigs which have a tortuous course in the conjunctiva, they pierce the sclerotic to reach the iris, where they anastomose with the long ciliaries.

The *anterior* and *posterior ethmoidal arteries* enter their respective canals and supply the mucous membrane of the ethmoidal cells; the anterior ethmoidal accompanies the nasal nerve into the anterior cranial fossa. In reviewing these arteries it will be noticed that four, the retinal, long, short, and anterior ciliaries, supply the eyeball solely; two, the muscular and lacrimal, supply the other intraorbital structures; while six, the supraorbital, two ethmoidals, nasal, frontal, and palpebral, go to parts outside the orbit.

The *Ophthalmic veins* are difficult to dissect unless they are specially injected; their chief points of interest are that they communicate freely in front with the facial vein, while behind they do not accompany the artery, since the larger part of them opens into the cavernous sinus through the anterior lacerated foramen, and the smaller joins the pterygoid plexus through the spheno-maxillary fissure. The course of the *optic nerve* and the position of the eyeball in the orbit should be carefully noted. It will be seen that the inner orbital wall is directly antero-posterior, while the outer slopes forwards and outwards from the optic foramen; consequently the axis of the cone which the orbit makes runs forwards and outwards from the apex, and the optic nerve lies in this axis. The antero-posterior axis of the eyeball therefore does not correspond either with the long axis of the orbit or the axis of the optic nerve. Notice, too, that the front of the cornea in the living eye comes well up to the level of the orbital margin, when a rod is placed vertically across it, but when the rod is placed transversely it will be seen that the cornea projects rather beyond the plane of the outlet.

Now cut the optic nerve and lift the distal end upwards in order to see the lower division of the third nerve and the sixth nerve, which lie below. The *lower division of the third nerve* can be traced through the anterior lacerated foramen, between the two heads of the external rectus, when it divides into branches for the internal and inferior recti, and the inferior oblique; the two former enter the ocular surfaces of their muscles very soon, but the latter is quite a long nerve which should be traced forwards to the posterior border of the inferior oblique muscle, giving off on its way the motor branch to the ciliary ganglion.

The *internal rectus muscle* [M. rectus medialis] should be examined next. It rises just internal to the optic foramen, and is remarkable for being the thickest of all the orbital recti muscles, as well as for being inserted nearest (about

7 mm.) to the sclero-corneal junction. These points are often useful in determining the side to which an extirpated eyeball belongs.

The *inferior rectus muscle* rises below the optic foramen, and runs forwards and outwards, to be inserted in a corresponding position on the lower hemisphere of the eyeball to that occupied by the insertion of the superior rectus on the upper.

Cut the inferior rectus and raise the eyeball in order to see the next muscle.

The *inferior oblique muscle* rises from the antero-internal part of the floor of the orbit, and runs backwards and outwards below the inferior rectus to be inserted into the postero-external part of the eyeball; it will therefore pull the back of the globe inwards and downwards, and so make the cornea look upwards and outwards. The superior rectus, it will be remembered, makes the eye look upwards and inwards, so that, if the two muscles act together, the eye will look straight upwards. In the same way it will be realised that the inferior rectus, acting with the superior oblique, will direct the eye straight downwards. For purely vertical movements of the eye, therefore, the proper rectus will always act with the other oblique muscle.

The inferior oblique may be better exposed by cutting and reflecting the inferior rectus. On the left side a dissection of the inferior oblique should be made from the front by cutting through the inferior palpebral ligament (see Fig. 98).

The *sixth nerve* enters the orbit through the anterior lacerated foramen, and passes between the two heads of the external rectus, on the outer side of the lower division of the third nerve. It very soon enters the ocular surface of the external rectus, which it supplies.

On reviewing the contents of the posterior half of the orbit, it will be noticed that the fourth, frontal (5 f.) and lacrimal (5 l.) nerves are above; then come the levator palpebræ and superior rectus muscles (M.); then the upper

division of the third (3 a.), the nasal branch of the fifth (5 n.), and the ophthalmic artery (A.); below these the optic nerve (N.); and, finally, the lower division of the third (3 b.) and the sixth nerves. Arranged in a diagrammatic way the structures have this order:—

4, 5 (f. and l.).
M.
3 (a.), 5 (n.), A.
N.
3 (b.), 6.

Now cut the muscles which have not been already divided, and remove the eyeball to a vessel containing spirit and water, or formalin solution. The back of the orbit shows the optic foramen with the origins of the recti muscles round it; they rise from a fibrous ring, almost a tube, which is really nothing more than the four coalesced tendons of origin. The tube is interrupted by the fact that the external rectus rises by an upper head which is internal to the anterior lacerated foramen, and a lower which comes from the outer side, and in this way all the structures, coming through the anterior lacerated foramen, except the frontal, lacrimal and fourth nerves, are said to pass between the two heads of the external rectus. Below and outside the optic foramen the spheno-maxillary fissure lies. In the recent state very little is seen of it, because it is closed in by membrane continuous with the periosteum, excepting where the veins, nerves, and lymphatics go through it. The veins have been described already, the nerves are the infraorbital, and its orbital branch the temporo-malar.

The *infraorbital nerve,* or continuation of the second division of the fifth, is easily found running forward in a groove in the posterior part of the orbital floor, but as the front of the orbit is approached the groove becomes a canal which, a quarter of an inch behind the orbital margin, turns

downwards and forwards rather suddenly to open on to the face.

The roof of the canal should be chiselled away, so as to expose the whole intraorbital course of the nerve, but the nerve itself should not be interfered with at present. A small infraorbital branch of the internal maxillary artery accompanies the nerve.

The *temporo-malar nerve* [N. zygomaticus] is a branch of the second division of the fifth before the latter enters the orbit; it should be looked for in the lower and outer angle of this cavity, gradually creeping up as it runs forward to enter the temporo-malar canal in the malar bone. While still within the orbit, it gives a communicating branch to the lacrimal nerve.

On the left side the dissection from in front should be carried as far back as possible. It is very important to get a good idea of the relative positions of structures from this point of view, because this is how they have to be approached [illegible] The tendons of all four recti, the superior and inferior oblique muscles, the lacrimal gland and terminal parts of the supraorbital, supratrochlear and infratrochlear nerves, as well as of the ophthalmic artery, may be reached. Divide each tendon close to its ocular attachment and try to draw it back through the opening in the roof; the resistance will give some idea of the value of the check ligaments.

In cutting the tendons the capsule of Tenon is, of course, opened; it should now be reflected back with a probe or seeker until the optic nerve is reached. Now press down with the probe on the lower part of the capsule, and notice how strong it is and how well it is attached by areolar planes to the orbital wall on each side. This strengthening is sometimes called the *suspensory ligament of Lockwood*, though as a definite structure it is often hard to demonstrate. The practical point, however, is clear enough that the eyeball will not drop even though the maxilla be removed, provided that the side-walls of the orbit are not cut away too high.

Divide the optic nerve, close to the eyeball, through the anterior orbital aperture; this is best done with curved scissors, and then the left eye can be removed for future examination.

THE EYE

In subjects injected with formalin the eyeball, although sometimes rather collapsed, is quite useful for examination, but its anatomy can always be more easily followed if three or four fresh bullocks' eyes are ordered from the nearest slaughter-house. It is altogether undesirable to study the eyes of any other mammal without at least one human eye for reference, because it is so important to have a clear idea of the relative size of the different parts in man.

Taking one of the human eyes already removed, notice that it is a sphere of practically an inch in diameter in every direction (a small fraction longer antero-posteriorly), and that anteriorly the cornea or transparent part bulges forwards slightly. Posteriorly the optic nerve joins the sphere internal to and a trifle below the point at which the antero-posterior axis would emerge.

Forming a ring round the entrance of the optic nerve are the points of entry of the long and short ciliary arteries and nerves, while the veins (*venæ vorticosæ*) come out in four or five places a little behind the equator or vertical transverse (coronal) section, midway between the anterior and posterior poles of the eye.

Look at the cut end of the optic nerve, and notice that it has a very thick fibrous sheath, which with care may be separated a little from the true nerve tissue within it, since there is a small lymph space between. This separation is more easily made out by splitting the nerve a little in a longitudinal direction. It is not at all easy to tell which eye is being looked at unless the tendons of the two oblique muscles are left fairly long; if they are cut very short, remember that they are attached fairly close together on the

outer side of the eye and behind the equator. The inner side, too, can generally be localised by the junction of the optic nerve mentioned above, as well as by the fact that the internal rectus attachment is the broadest of all and nearest the sclero-corneal junction. The upper pole can generally be told by the tendon of the superior oblique being so much narrower than that of the inferior, while the latter is between the external rectus insertion and the optic nerve, and approaches the optic nerve more closely than does the insertion of any other muscle.

The diameter of the cornea is about half an inch, slightly greater transversely than vertically. Make an antero-posterior section of one eye and an equatorial (transverse vertical) section of the other. This may be done with a really sharp knife or razor, but it is infinitely better to go to a little further trouble and freeze the eyeballs on a freezing microtome, or in a mixture of ice and salt. When they are frozen hard, a fret or other fine saw is the best thing with which to cut them. After this they should be placed in a dish of weak spirit and water, and, as they begin to thaw, their surface lightly brushed with a camel's-hair brush. The author finds a little socket of plasticine an excellent way of keeping them steady. Now examine the sections, and notice that there are three coats: (1) an outer protective formed by the *sclerotic* [sclera] in the posterior five-sixths, and the *cornea* in the anterior sixth; (2) an intermediate vascular and pigmented coat, the *choroid* [chorioidea], posteriorly, and the *ciliary bodies*, and *iris* anteriorly; (3) a delicate nervous inner layer, the *retina*. Of these coats the innermost is so thin that it tears with the slightest touch.

The *sclerotic* is nearly twice as thick posteriorly, where it is reinforced by the sheath of the optic nerve, as it is at the equator; but in front of that the recti join it, and so it gets a little thicker near its junction with the cornea.

The *cornea*, too, is thicker near the sclero-corneal junction than at the anterior pole of the eye. Both these parts

of the outer coat are made of fibrous tissue, with cells and minute lymph channels among the fibres, but in front all these structures have the same refractive index, and so the cornea is transparent. The cornea has an elastic membrane

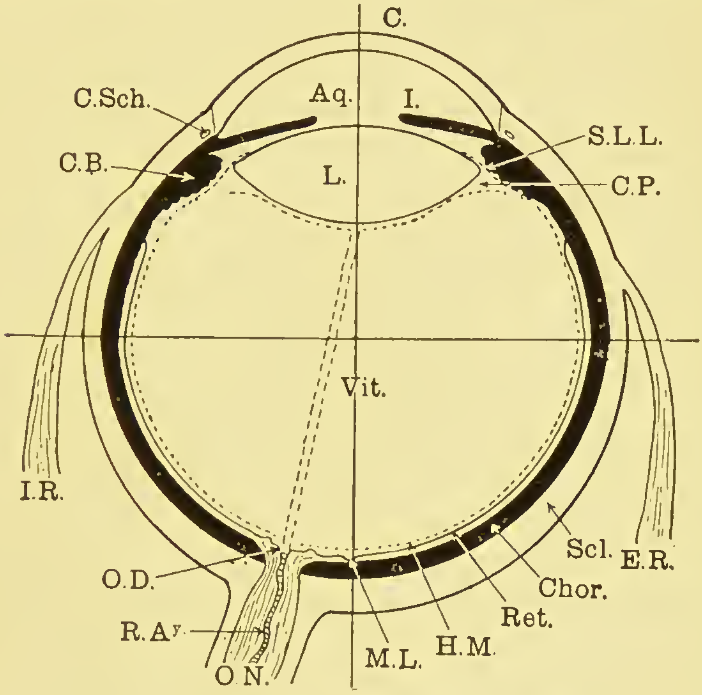


FIG. 100.—HORIZONTAL SECTION OF EYEBALL.

C. Cornea. *Aq.* Aqueous Humour. *I.* Iris. *S.L.L.* Suspensory Ligament of Lens. *C.P.* Canal of Petit. *E.R.* External Rectus. *Scl.* Sclerotic. *Chor.* Choroid. *Ret.* Retina. *H.M.* Hyaloid Membrane. *M.L.* Macula Lutea. *O.N.* Optic Nerve. *R.A^y.* Retinal Artery. *O.D.* Optic Disc. *I.R.* Internal Rectus. *Vit.* Vitreous Humour. *C.B.* Ciliary Body. *C.Sch.* Canal of Schlemm. *L.* Lens.

in front of and behind it, but these cannot be seen with the naked eye.

If the sclero-corneal junction is examined carefully with a hand lens, the small aperture of the *Canal of Schlemm* [sinus venosus scleræ] is seen; it is really a venous sinus.

The *Choroid coat* is continued forwards into the iris, and

is pigmented. Posteriorly it is perforated by the optic nerve, while anteriorly, just before it joins the iris, it becomes folded to form the ciliary bodies, to be noted later. It is essentially a vascular coat, and its deeper layer, the *chorio-capillaris*, nourishes the outer layers of the retina.

The *Iris* is the diaphragm which, by varying the size of its opening—the *pupil*—can regulate the amount of light admitted to the eye. It lies very close to and just in front of the lens, although there is a small triangular space known as the *posterior aqueous chamber* between the two, and bounded externally by the bases of the ciliary processes. It is thus seen that only the pupillary margin of the iris is in contact with the lens capsule. The *anterior aqueous chamber* lies between the cornea and the iris, and is about an eighth of an inch from before backwards.

The *Retina* is seen as an extremely delicate, whitish membrane, which easily separates from the choroid, especially when the vitreous humour is removed. This "detachment of the retina" sometimes occurs in life as the result of a blow on the eye. As a matter of fact, the whole of the retina is not present in the delicate white membrane, because there is a layer of very black pigment[1] which developmentally belongs to the retina, but is left behind on the choroid when the retina separates from it. This pigmented layer, lined internally by columnar epithelium, is continued forwards over the inner surface of the ciliary processes, and here is supposed to play an important part in the secretion of the aqueous humour; it is known as the *pars ciliaris retinæ*. On the back of the iris, too, the black pigment layer, together with the columnar cells, here also pigmented, is very marked, and is called the *pars iridica retinæ*.

The *Lens* in the dissecting-room is opaque, especially if spirit has come near it. It is enclosed in a structureless capsule, though this is not visible to the naked eye. In the section it is bi-convex, with the anterior surface a good

[1] Tapetum.

deal flatter than the posterior. It is about ⅓ inch in diameter, a measurement of importance in cataract operations, since a slit through which it can pass out has to be made in the limbus or sclero-corneal junction. The *vitreous humour* fills the cavity of the eyeball behind the lens; it is of the consistence of a very thin jelly, and is enclosed by a delicate capsule called the *hyaloid membrane.* Anteriorly this membrane splits into two layers, the anterior of which passes in front of the lens and blends with its capsule. It is closely pressed against the ciliary processes and firmly fixed to them in passing. It is known as the *suspensory ligament of the lens*, and, when the ciliary processes are drawn forwards, will relax and allow the front of the lens to become more convex through its own elasticity.

The posterior layer of the splitting continues to enclose the vitreous, and lies in close contact with the back of the lens. Between the two layers of the split membrane there is a space surrounding the margin of the lens known as the *canal of Petit* [spatia zonularia]. Running right through the vitreous humour, from the entrance of the optic nerve to the middle of the back of the lens, is the *hyaloid canal.* In the fœtus this canal transmitted a branch from the retinal artery to the back of the lens. In the fœtus, too, the lens was connected to the iris and received blood vessels from it. Remnants of this are sometimes found in the pupil after birth as "persistent capsulo-pupillary membrane."

Now take the posterior half of the eyeball which was divided transversely, and scoop out the vitreous humour as gently and carefully as possible. It will be seen to retain its shape, owing to the hyaloid membrane and to a minute and very delicate network in its interior, if it is received into a vessel of water. On examining the retina, preferably with a magnifying lens, the *optic disc* [papilla nervi optici] will be seen opposite the point where the optic nerve enters (3 mm. to the inner or nasal side of the posterior pole of the eye). It is a circular disc only 1·5 mm. across, and in

its centre is the place where the retinal artery breaks up into radiating branches for the innermost layers of the retina. The disc is of great clinical importance, and is examined with the ophthalmoscope in the living body. Its surface is slightly raised, and, as it only consists of nerve fibres, it is spoken of by physiologists as the "*blind spot.*"

At the posterior pole of the eye, and therefore 3 mm. to the outer (temporal) side of the disc, is the *macula lutea* or *yellow spot*—oval, with its long axis (2 to 3 mm.) horizontal. It is the seat of most acute vision.

Cut one of the fresh bullocks' eyes through transversely,[1] and, after removing the vitreous, look for the optic disc; try to notice particularly the arrangement of the arteries and veins in it. There is no yellow spot in the ox, since this only occurs in animals which use their eyes for binocular vision. On the other hand, a beautiful iridescent colouring, not found in man, is present in the retina of the ox, and is known as the tapetum.

In the anterior half of the eye remove the vitreous humour and trace the retina forwards. A little behind the region of the ciliary bodies its nervous elements end in a scalloped edge called the *ora serrata,* though a pigmented and epithelial layer is continued forwards as the *pars ciliaris* and *pars iridica retinæ.*

Everything seen in this half of the bullock's eye should be checked in the corresponding half of the human eye, as far as its condition will allow.

In removing the lens, look at its posterior surface for a mark like an upright Y. This shows the place where the various lamellæ of which it is composed are joined together. When the lens is removed, look at its anterior surface, which bears a similar mark, only the Y is now inverted. Of course, these marks are only apparent when the transparency of the structures has disappeared.

[1] This should be done with scissors, unless it is frozen, and cut with the saw like the others.

The lens having been removed, the *ciliary bodies* are seen from behind; they are about seventy in number, radially arranged, each one swelling anteriorly to a thickened, rounded base which lies just behind the iris. The pigment of the retina which covers them makes them look very black.

The term ciliary processes is often used as a synonym for ciliary bodies, but, clinically, by *ciliary processes* are understood a delicate fringe of vascular glomeruli which is present on the convex surface of each ciliary body.

Next cut through the cornea close to the sclero-corneal junction three-quarters of the way round, and open it like a lid. Lining the back of the cornea is the *posterior elastic membrane* [lamina elastica posterior], which may be peeled away from the cut edge for a little, and is continued on to the front of the iris as a series of delicate ridges with hollows between. This is the *ligamentum pectinatum iridis*, and the hollows are the *spaces of Fontana* [spatia anguli iridis]. It is here that the aqueous humour, secreted by the surface of the ciliary bodies, is believed to percolate into the adjacent canal of Schlemm.

The *iris* can now be seen from the front and back, and it will be noticed that in the ox its pupil is a transverse slit, while in man it is circular. Behind, the iris has the black pigment of the pars iridica retinæ, but seen from the front its colour may range from the dark brown of the ox or negro to the leaden blue of the child at birth, according to the amount of interstitial pigment of various shades which is deposited in the stroma of the iris. When no such interstitial pigment is present the eye is blue, and on looking at living people's eyes it will be noticed that the interstitial pigment is always greater near the pupil than at the periphery of the iris.

The iris contains circular (sphincter) and radiating (dilator) muscular fibres, though they are difficult to demonstrate macroscopically; the former are massed round the pupil and are supplied by the third nerve, while the latter

are supplied *viâ* the short ciliaries, ciliary ganglion,[1] nasal nerve, cavernous plexus, cervical sympathetic and upper two or three thoracic spinal nerves. This complicated path is pointed out because it is of clinical importance.

Now take another bullock's eye and make a good-sized window in the sclerotic. Take it back nearly to the optic nerve and forward to near the ciliary region; reflect it carefully, keeping the eye in a vessel of water. The sclerotic will come away from the choroid quite easily, because there is a *perichoroidal lymph space* between them, crossed by some delicate pigmented cellular tissue called the *lamina fusca.* At the posterior part of the space look for the ciliary nerves and arteries sinking gradually into the choroid as they run forwards. Notice, too, the characteristic whorls made by the venæ vorticosæ.

Take a tangential slice off the sclerotic where the optic nerve is entering; if the cut surface be carefully looked at it is sometimes seen that, while the sheath of the nerve joins the sclerotic, the nerve fibres pass through a number of small holes in the fibrous tissue, which is therefore called the *lamina cribrosa.* Lastly, cut out a piece of the ciliary region showing the junction of the cornea, sclerotic, iris, and ciliary bodies; examine the cut surface very carefully with a hand-lens to see the *ciliary muscle* rising from the sclero-corneal junction, close to the canal of Schlemm, and running backwards into the ciliary bodies in a fan-like manner. Internal to these there are some circular fibres, but it is very difficult to make them out without a microscope.

Another point which cannot be demonstrated in the dissecting-room, but is of great clinical importance, is that the ciliary region derives most of its blood from the *anterior ciliary arteries,* which enter the anterior part of the eyeball near the attachment of the muscles. It may also interest the student to know that, while the ciliary region and iris are liberally supplied with nerves of sensation, the choroid is very insensitive.

[1] Or long ciliaries and nasal nerve; see footnote on p. 207.

Spheno-maxillary Fossa [F. Pterygo-palatina]

This space should be carefully studied on the dried skull, and its various openings noticed before any dissection is attempted. In it lie the terminal part of the internal maxillary artery, a short length of the superior maxillary division of the fifth nerve, and the spheno-palatine, or Meckel's ganglion, hanging from the latter. As these structures give off numerous branches, the small space is well filled, and their satisfactory exposure calls for some skill and ingenuity.

Two or three small French nails driven into a block of wood at convenient distances make a good rest for supporting the part in various positions, while a fret-saw, small sharp chisel, and small bone forceps or very strong scissors are the best tools with which to work.

The dry skull must, of course, be at hand for reference.

First follow the internal maxillary artery into the fossa through the pterygo-maxillary fissure. Next localise the infraorbital nerve in the groove in the floor of the orbit, and cut away all that part of the maxilla, which lies external to the groove with the saw and forceps. This will give more room at once. Now trace the nerve from the orbit through the spheno-maxillary fissure across the roof of the fossa to the foramen rotundum in the posterior wall, and notice that in passing backwards the nerve runs almost directly inwards along the top of the posterior part of the maxilla.

Cut away the top of the foramen rotundum, and the whole length of the infraorbital nerve is exposed. Entering the orbit with the nerve is the *infraorbital branch of the internal maxillary artery*.

If the infraorbital nerve is now cut in the posterior part of the orbit and drawn gently backwards, its two posterior superior dental twigs may be seen, and may be traced down

to the posterior dental canals on the zygomatic surface of the maxilla. They are accompanied by small branches of the internal maxillary artery.

Hanging from the infraorbital nerve, or, more correctly speaking, from the maxillary division of the fifth, by two or three branches, *Meckel's ganglion* will be seen, though in order to get a good view it may be necessary to clear away the termination of the internal maxillary artery; a small loss, since its branches accompany those of the ganglion, and when once these are seen can be easily understood.

The ganglion is about the size of a grape seed, and running down from it are three descending branches, the *Great* and *Accessory palatine nerves;* they soon enter the posterior palatine canals, which may be laid open with the chisel. The descending palatine artery which accompanies the *Great* palatine nerve is quite a large branch.

Running into Meckel's ganglion from behind is the *Vidian nerve* [N. canalis pterygoidei], which passes through the Vidian canal, a tunnel through the root of the pterygoid plates.

If it is decided to follow up this canal, it is best to saw back through the great wing of the sphenoid from just internal to the foramen rotundum to the outer part of the foramen lacerum medium in the middle cranial fossa. This being done, the outer wall of the canal may be chiselled away.

The student is advised to attempt these more difficult pieces of dissection, even if he is unsuccessful, as the technical skill in using the chisel will stand him in good stead later on. In dissecting-rooms attached to hospitals it is generally possible to procure an assortment of chisels, forceps, and saws from the instrument-room, which have been discarded owing to their being of a slightly obsolete pattern, and these can be lent by the senior demonstrator as they are required.

When the Vidian nerve has been traced back to the

middle lacerated foramen, it is seen to be formed by the union of the *great superficial petrosal nerve* already exposed in the dissection of the middle cranial fossa (see p. 81) and the *great deep petrosal*, which comes from the carotid plexus of the sympathetic in the carotid canal.

The *Vidian branch of the internal maxillary artery* [A. canalis pterygoidei] accompanies the nerve backwards through its canal.

The *three roots of Meckel's ganglion* have now been accounted for. The sensory are the twigs by which the ganglion hangs from the second division of the fifth, the motor is the great superficial petrosal from the facial, and the sympathetic is the great deep petrosal from the carotid plexus.

The *pterygo-palatine branch of Meckel's ganglion* is a very small nerve which runs back to the roof of the pharynx in the pterygo-palatine canal, just internal to the root of the internal pterygoid plate; it therefore lies internal and inferior to the Vidian. To find it strip the mucous membrane away in this region, and break the sphenoidal process of the palate away from the sphenoid.

The last branches of Meckel's ganglion, *the naso-palatine* and *upper nasal branches*, have been seen in the nose, and may be traced to the ganglion by enlarging the spheno-palatine foramen; in other words, by cutting away some of the delicate vertical plate of the palate with a chisel or strong scissors. In this way the ganglion can be exposed from its inner side, and the naso-palatine artery traced into the fossa.

Before leaving this region it may be well to recapitulate the structures passing through the various openings in the spheno-maxillary fossa. They are: In the roof (spheno-maxillary fissure), infraorbital nerve, infraorbital artery, temporo-malar nerve. In the floor: 1. (posterior palatine canal), Great palatine nerve and artery; 2. (accessory palatine canals), accessory palatine nerves.

In the anterior wall (posterior superior dental canals), posterior superior dental nerves and arteries.

In the posterior wall: 1. (foramen rotundum), infraorbital nerve, here generally spoken of as the second division of the fifth; 2. (Vidian canal), Vidian nerve and artery; 3. (pterygo-palatine canal), pterygo-palatine nerve and artery.

In the outer wall (pterygo-maxillary fissure), internal maxillary artery.

In the inner wall (spheno-palatine foramen), naso-palatine nerve and artery, upper nasal nerves.

THE TONGUE

As the tongue has been partly examined in the mouth (p. 125), in the submaxillary region (p. 141), and in the pharynx, only those parts which have not already come into view need be dealt with here.

In the pharynx the V-shaped sulcus terminalis was noticed dividing the superior or dorsal surface from the posterior or pharyngeal. Just in front of this are seen the *circumvallate papillæ* [p. vallatæ], of which there are from seven to twelve. Notice that each has a flattened, disc-like, central elevation surrounded by a fossa or ditch, which in its turn is surrounded by a vallum or rampart.

At the back of the side of the tongue are some indistinct vertical ridges, the vestigial *foliate papillæ*, so well marked in rodents. It should be noticed that both these sets of papillæ are found in the area of the tongue supplied by the glosso-pharyngeal nerve.

The thread-like *filiform* and button mushroom-like *fungiform* papillæ occupy the dorsum, to which the lingual nerve is distributed.

Make a coronal section of the tongue, and notice the arrangement of its intrinsic muscles; the extrinsic have already been dealt with (p. 141). In the mid line is the fibrous septum, and if the organ is well injected it will be

noticed how little anastomosis there is across the middle line. Owing to this, it is possible to divide the tongue with very

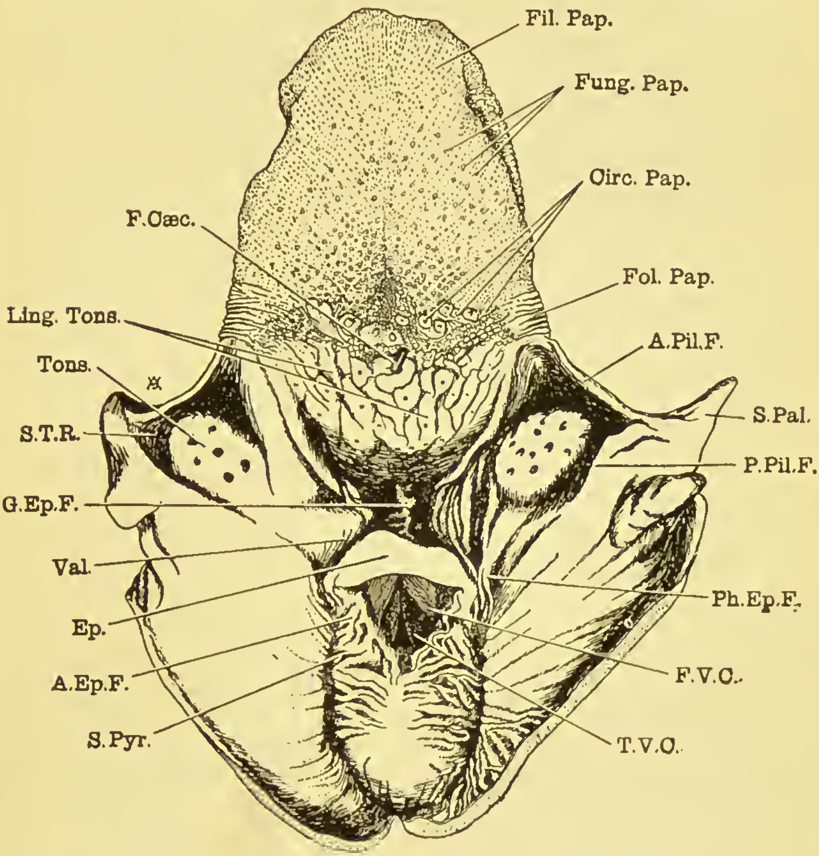


FIG. 101.—DORSUM OF TONGUE AND OPENING OF LARYNX.

Fil.Pap. Filiform Papillæ. *Fung.Pap.* Fungiform Papillæ. *Circ.Pap.* Circumvallate Papillæ. *Fol.Pap.* Foliate Papillæ. *F.Cæc.* Rod in Foramen Cæcum. *Ling.Tons.* Mucous Crypts in Lingual Tonsil. *Tons.* Tonsil. *S.T.R.* Supratonsillar Recess. *A.Pil.F.* Anterior Pillar of Fauces. *S.Pal.* Soft Palate cut and reflected. *P.Pil.F.* Posterior Pillar of Fauces. *G.Ep.F.* Glosso-epiglottic Fold. *Ph.Ep.F.* Pharyngo-epiglottic Fold. *Val.* Vallecula. *Ep.* Epiglottis. *A.Ep.F.* Aryteno-epiglottic Fold. *S.Pyr.* Sinus Pyriformis. *F.V.C.* False Vocal Cord. *T.V.C.* True Vocal Cord.

little bleeding, as long as the operator keeps strictly to the mid line. The greater part of the section is occupied by the

transverse lingualis [M. transversus linguæ], the fibres of which are attached to the median septum, while laterally they end on the deep surface of the mucous membrane, except posteriorly, where they are continuous with those of the palato-glossus (p. 192). Among these are interwoven vertical fibres, the upward continuation of the genio-hyo-glossus medially and hyo-glossus laterally.

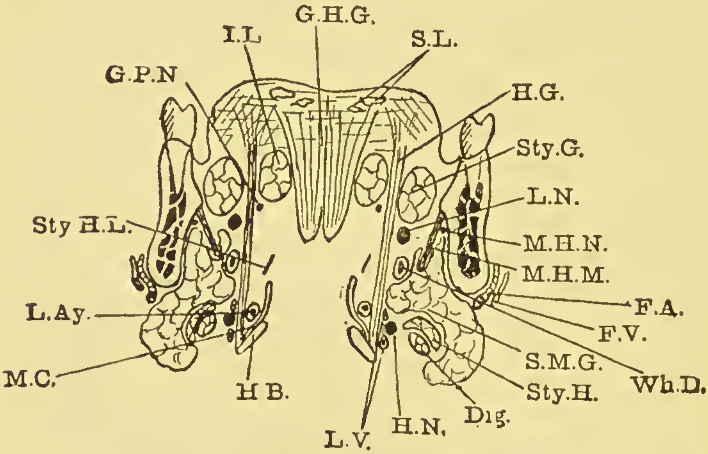


FIG. 102.—CORONAL SECTION THROUGH THE BACK OF THE TONGUE TO SHOW THE RELATIONS OF THE HYO-GLOSSUS MUSCLE.

G.H.G. Genio-hyo-glossus. *S.L.* Superficial Lingualis. *H.G.* Hyo-glossus. *Sty.G.* Stylo-glossus. *L.N.* Lingual Nerve. *M.H.N.* Mylo-hyoid Nerve. *M.H.M.* Mylo-hyoid Muscle. *F.A.* Facial Artery. *F.V.* Facial Vein. *Wh.D.* Wharton's Duct. *S.M.G.* Submaxillary Gland. *Sty.H.* Stylo-hyoid. *Dig.* Digastric. *H.N.* Hypoglossal Nerve. *L.V.* Lingual Veins. *H.B.* Hyoid Bone. *M.C.* Middle Constrictor. *L.Ay.* Lingual Artery. *Sty.H.L.* Stylo-hyoid Ligament. *G.P.N.* Glosso-pharyngeal Nerve. *I.L.* Interior Lingualis.

Towards the side of the tongue are a number of oblique fibres running upwards and inwards, sometimes known as the *oblique lingualis.* Two antero-posterior bundles of fibres are cut in section. Of these the *superior lingualis* lies close to the mucous membrane of the dorsum, while the *inferior lingualis* is a larger and more circumscribed bundle lying between the hyo-glossus and genio-hyo-glossus (see Fig. 102).

If sections are made further forward the inferior lingualis

is seen to blend with the stylo-glossus in front of the hyo-glossus. The inferior lingualis is sometimes said to be attached to the body of the hyoid bone posteriorly, but the author, in a large number of dissections, has never been able to see this.

A section passing upwards from the lesser cornu of the hyoid bone will probably display the little *chondro-glossus*

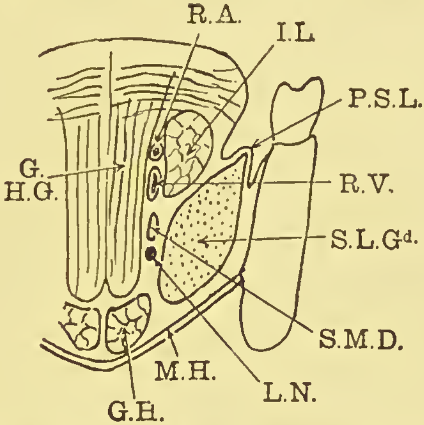


FIG. 103.—DIAGRAMMATIC TRANSVERSE SECTION OF TONGUE TO SHOW THE RELATIONS OF THE SUBLINGUAL GLAND.

R.A. Ranine Artery. *I.L.* Inferior Lingualis Muscle. *P.S.L.* Plica Sublingualis. *R.V.* Ranine Vein. *S.L.G^d^.* Sublingual Gland. *S.M.D.* Submaxillary (Wharton's) Duct. *L.N.* Lingual Nerve. *M.H.* Mylo-hyoid Muscle. *G.H.* Genio-hyoid Muscle. *G.H.G.* Genio-hyo-glossus Muscle.

(see p. 145), many of the fibres of which blend with the inferior lingualis and lie between the hyo- and genio-hyo-glossus.

As the tip of the tongue is approached, the *apical glands* (of Nuhn) [Gl. lingualis anterior] should be looked for on the lower surface, one on each side of the mid line. To expose these a part of the musculature of the tongue must be removed.

Notice how closely the mucous membrane is bound to the muscular tissue on the dorsum and sides of the tongue, but below and on the posterior surface a good deal of sub-mucous tissue is present.

DISSECTION OF THE LARYNX

When a fresh larynx can be obtained, as is often the case, it is preferable to the one on the student's own part, because by this time the latter is probably rather dry. If no fresh one is available, the larynx should be removed from the part just above the hyoid bone, taking care not to injure the epiglottis.

First review the epiglottis, aryteno-epiglottidean folds, and arytenoid cartilages already seen in the dissection of the pharynx, and notice how these structures form the orifice of the larynx.

Next look down into the laryngeal cavity, where the *glottis* or *rima glottidis* will be seen as a chink between the two *true vocal cords* [ligamenta vocalia], which it is possible to widen or narrow, as the cords are separated or brought together.

Notice that the term "glottis" only refers to this space, and should not be used for the whole larynx, as is sometimes done.

On running a seeker along the edge of the true cords, it will be found that they are attached close together to the re-entering angle of the thyroid cartilage in front, while behind each is fastened to a slender process which projects forward for about a quarter of an inch from the base of the arytenoid cartilage to meet it.

The tip of this *vocal process* may be made to approach or leave its fellow by turning the arytenoid cartilage on its vertical axis, and this is one movement which occurs during life; but, in addition, the arytenoids may be drawn bodily towards or away from one another along the top of the back of the cricoid cartilage.

When the glottis is closed it is a mere antero-posterior line, but when as much room as possible is required it becomes a lozenge-shaped space.

Above the true, the *false vocal cords* [ligamenta ventricularia] are seen; they are folds of mucous membrane,

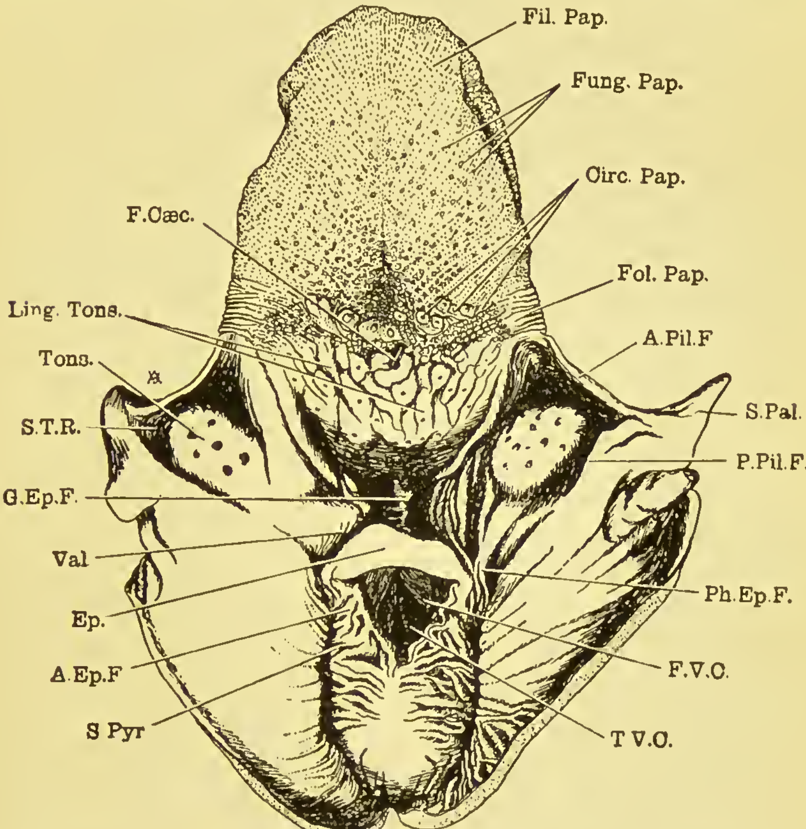


FIG. 104.—DORSUM OF TONGUE AND OPENING OF LARYNX.

Fil.Pap. Filiform Papillæ. *Fung.Pap.* Fungiform Papillæ. *Circ.Pap.* Circumvallate Papillæ. *Fol.Pap.* Foliate Papillæ. *F.Cæc.* Rod in Foramen Cæcum. *Ling.Tons.* Mucous Crypts in Lingual Tonsil. *Tons.* Tonsil. *S.T.R.* Supratonsillar Recess. *A.Pil.F.* Anterior Pillar of Fauces. *S.Pal.* Soft Palate cut and reflected. *P.Pil.F.* Posterior Pillar of Fauces. *G.Ep.F.* Glosso-epiglottic Fold. *Ph.Ep.F.* Pharyngo-epiglottic Fold. *Val.* Vallecula. *Ep.* Epiglottis. *A.Ep.F.* Aryteno-epiglottic Fold. *S.Pyr.* Sinus Pyriformis. *F.V.C.* False Vocal Cord. *T.V.C.* True Vocal Cord.

rather more widely separated than are the true cords.

Between the true and false cords of each side is the

opening of the *laryngeal saccule* [ventriculus laryngis], which will be explored later.

On looking down into the larynx from in front, a rounded convexity on the epiglottis, near its attachment, will be seen. This is the *cushion of the epiglottis* [tuberculum epiglotticum], and is very much in the way in using the laryngoscope, since it hides the anterior commissure of the true vocal cords.

Push a needle through the crico-thyroid space, and notice that it enters the larynx below the level of the true vocal cords, a piece of anatomical knowledge which may be of great value in an emergency.

The Muscles and Nerves of the Larynx

Now dissect the muscles carefully on one side. The larynx is sometimes nailed to a block of wood during its dissection, but, as any change of position necessitates drawing the nails and putting in others, it will be found more convenient to drive two nails an inch apart into a block in such a way that they slope away from one another.

These will hold the larynx in any required position without injuring it. Where small sandbags are provided, these form by far the best way of steadying irregular-shaped objects; they may be covered with well-oiled canvas.

The *crico-thyroid muscle* [M. crico-thyreoideus] rises from the lower border of the thyroid cartilage as well as from the front of the inferior cornu, and is inserted into the antero-lateral part of the ring of the cricoid cartilage. The external branch of the superior laryngeal nerve has been traced to it already.

By drawing the front part of the cricoid up towards the thyroid, its posterior part, which supports the arytenoids, is tilted back, and so the arytenoids have to go back too, thus stretching the true cords.

While dissecting the following muscles, it will be advisable to trace the branches of the *recurrent laryngeal nerve* to them. The trunk of the nerve was preserved in the groove between the trachea and œsophagus, and it should now be made tense with hooks.

A little behind the inferior cornu of the thyroid cartilage, and close to its articulation with the cricoid, the nerve divides into two branches. Of these the anterior supplies the crico-arytenoideus lateralis and thyro-arytenoideus, while the posterior passes through the crico-arytenoideus posticus and then enters the arytenoideus. It is this latter branch which communicates with the internal laryngeal nerve.

Notice that all the laryngeal muscles receive their nerves on their superficial aspects.

Divide one ala of the thyroid cartilage by a vertical incision a little to one side of the middle line, and remove it by freeing the mucous membrane.

In doing this remember that the thyroid cartilages are usually more or less ossified after middle life.

Look for the *thyro-arytenoideus muscle*, which rises in front close to the angle of the thyroid cartilage and runs back to be inserted into the antero-external surface of the pyramidal arytenoid. A few fibres pass up to the side of the epiglottis, while others form a delicate sheath for the surface of the laryngeal saccule, and are known as the *compressor sacculi laryngis* [M. ventricularis]. Lying parallel and immediately external to the true vocal cord is a slightly thickened bundle, known as the *thyro-arytenoideus internus* [M. vocalis], some of the fibres of which are inserted into the cord.

The thyro-arytenoid will obviously draw the arytenoid cartilage forward and so relax the cord, in this way acting as an antagonist to the crico-thyroid; but when the two muscles act together the latter is the more powerful, and the thyro-arytenoideus will then, by its contraction, approximate the two cords with the accuracy necessary for proper phonation.

Dissect the mucous membrane away from the posterior surface of the larynx, and look for the *arytenoideus muscle* [M. arytenoideus transversus], which runs transversely across from the concave posterior surface of one arytenoid to that of the other. On its surface there are some diagonal fibres which run from the lower and outer angle of each arytenoid, crossing one another like an **X**, to be continued upwards and outwards into the aryteno-epiglottidean fold of the

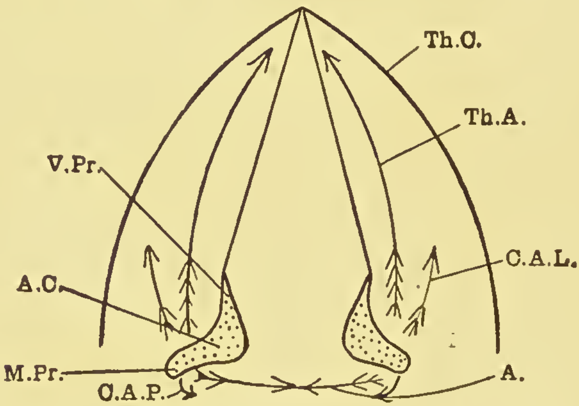


FIG. 105.—SCHEME OF LARYNGEAL MUSCLES.

Th.C. Thyroid Cartilage. *A.C.* Arytenoid Cartilage. *Th.A.* Thyro-arytenoideus. *C.A.L.* Crico-arytenoideus Lateralis. *C.A.P.* Crico-arytenoideus Posticus. *A.* Arytenoideus. *V.Pr.* Vocal Process of Arytenoid. *M.Pr.* Muscular Process of Arytenoid.

opposite side. These are sometimes known as the *aryteno-epiglottideus muscle* [M. arytenoideus obliquus] (see Fig. 106).

It is clear that the arytenoideus muscle must draw the two arytenoid cartilages towards one another (see Fig. 105).

The *crico-arytenoideus posticus muscle* rises from its own side of the posterior expanded or signet part of the cricoid cartilage; its fibres, converging, run upwards and forwards to the back of the muscular process of the arytenoid, a stout process projecting outwards from the outer side of the base of that cartilage. This muscle, by pulling the muscular process back, rotates the arytenoid on its vertical axis, and

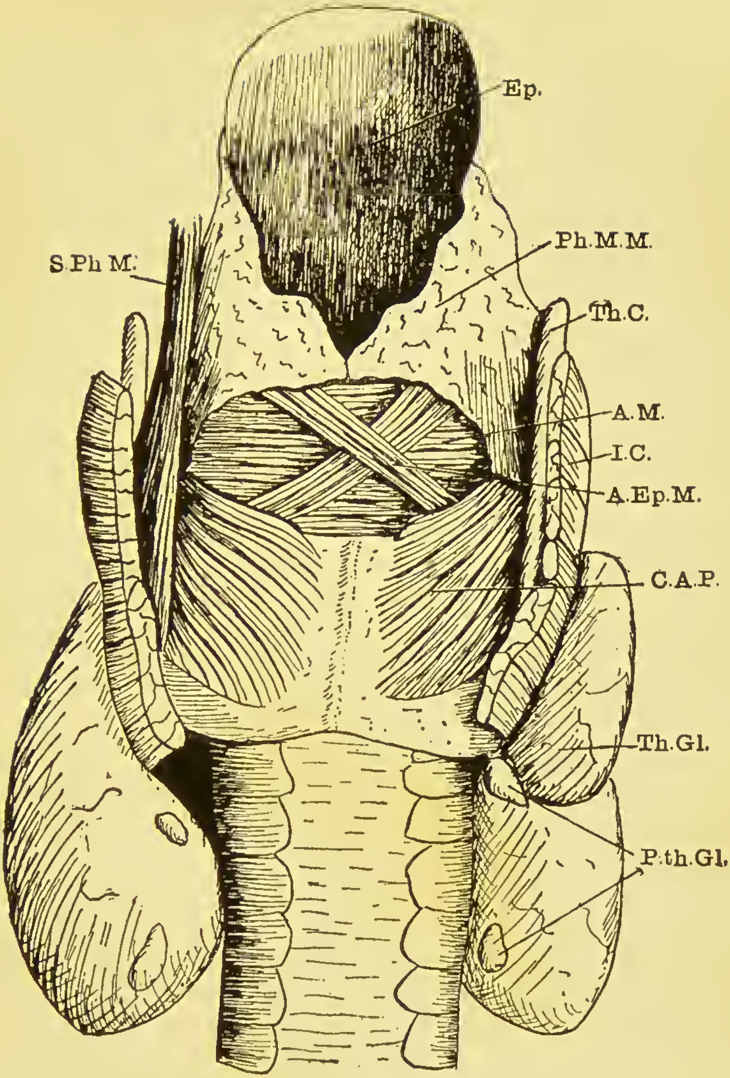


FIG. 106.—DISSECTION OF THE LARYNX FROM BEHIND.

Ep. Epiglottis. *Ph.M.M.* Pharyngeal Mucous Membrane. *Th.C.* Upper Cornu of Thyroid Cartilage. *A.M.* Arytenoideus Muscle. *I.C.* Inferior Constrictor. *A.Ep.M.* Aryteno-epiglottideus Muscle. *C.A.P.* Crico-arytenoideus Posticus Muscle. *Th.Gl.* Thyroid Gland. *P.th.Gl.* Parathyroid Glands, in this specimen singularly distinct. *S.Ph.M.* Combined Insertions of Stylo- and Palato-pharyngeus Muscles.

so turns the vocal processes outwards and separates the vocal cords (see Fig. 105).

The *crico-arytenoideus lateralis* should be looked for just below the thryo-arytenoideus. It rises from the upper border of the lateral part of the ring of the cricoid (see Fig. 107), and its fibres run back to the front of the muscular process of the arytenoid cartilage, which it thus draws forwards, and so turns the vocal process inwards, thus approximating the cords (see Fig. 105).

In this way it acts as the antagonist of the crico-arytenoideus posticus, though when these two muscles contract at the same time they neutralise one another's rotating power, draw the arytenoid cartilage away from its fellow, and so become antagonists of the arytenoideus.

The distribution of the *internal branch of the superior laryngeal nerve* should now be traced on the hitherto undissected side. This is the sensory nerve of the larynx, which it enters by piercing the thyro-hyoid membrane a little in front of the upper cornu of the thyroid cartilage (see Fig. 107).

The membrane should not be interfered with, but the nerve picked up after it has passed through. To do this make the nerve tense with hooks and dissect through the mucous membrane forming the floor of the sinus pyriformis. Some twigs may be followed upwards and inwards to the epiglottis and back of the tongue, while others run down to supply the rest of the mucous membrane of the larynx as low as the true vocal cords.

With a little care a communication may be traced to the branch of the recurrent laryngeal which supplies the arytenoideus muscle.

The *thyro-hyoid membrane* [M. hyothyreoidea] should now be examined; it consists of a central part running from the upper border of the thyroid cartilage to the upper border of the body of the hyoid bone and more posteriorly to the inner border of the great cornu. Between

it and the posterior concave surface of the hyoid is a small bursa.

This arrangement allows the thyroid cartilage to be pulled up behind the body of the hyoid in deglutition. Though the ligament is very strong and elastic in the mid line, it fades away laterally, where it is pierced by the superior laryngeal nerve and artery; but from the tips of the superior cornua of the thyroid the *lateral thyro-hyoid ligaments* [Ll. hyothyreoidea lateralia] run up to the tips of the great cornua of the hyoid bone, and these are regarded as the thickened posterior edges of the membrane.

In each of these a small knob of cartilage (cartilago triticea) is sometimes found.

The *crico-thyroid membrane* [ligamentum crico-thyreoideum], like the thyro-hyoid, consists of median and lateral parts. Of these the median part really deserves its name, since it is attached below to the top of the anterior part of the ring of the cricoid, while above it is fastened to the lower border of the thyroid cartilage, though, as this upper attachment is broader than the lower, the median part of the membrane is an inverted triangular sheet.

The lateral part should be studied on both sides.

On the side in which the thyroid cartilage has been left the membrane may be seen to pass up from the lateral part of the ring of the cricoid cartilage internal to the thyroid, and a forceps blade may be pushed up between the two structures for a little distance.

On the other side, whence the thyroid cartilage has been removed, the membrane is seen to pass up deep to the crico-arytenoideus lateralis, and if this muscle, as well as the thyro-arytenoideus, are cleared away, then it may be traced up to the true vocal cord; for this reason the cord is sometimes described as the upper free edge of the lateral part of the crico-thyroid membrane (see Fig. 107).

The whole of this membrane, like the thyro-hyoid, is

very elastic, and this is especially the case with the true vocal cords.

The JOINTS OF THE LARYNX are two on each side; one between the inferior cornu of the thyroid cartilage and the

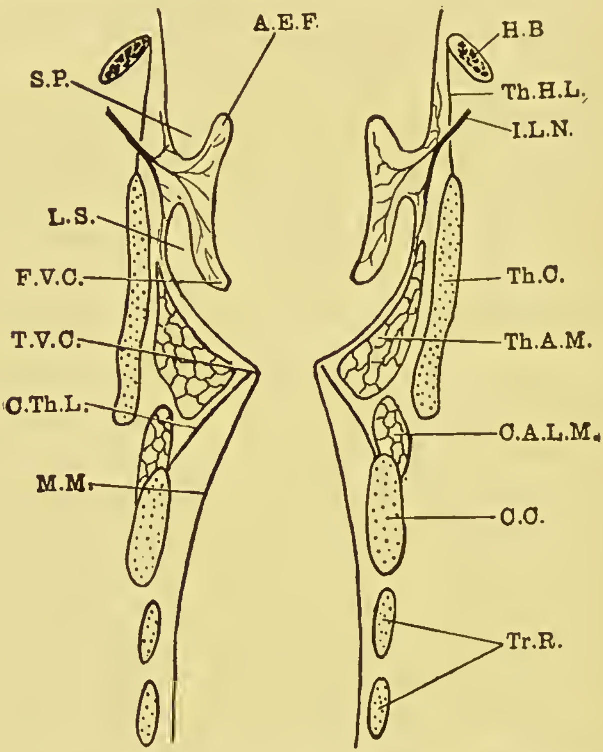


FIG. 107.—CORONAL SECTION OF THE LARYNX (SEMI-DIAGRAMMATIC).

H.B. Hyoid Bone. *Th.H.L.* Thyro-hyoid Membrane. *I.L.N.* Internal Laryngeal Nerve. *Th.C.* Thyroid Cartilage. *Th.A.M.* Thyro-arytenoideus Muscle. *C.A.L.M.* Crico-arytenoideus Lateralis Muscle. *C.C.* Cricoid Cartilage. *Tr.R.* Tracheal Rings. *M.M.* Mucous Membrane. *C.Th.L.* Crico-thyroid Membrane. *T.V.C.* True Vocal Cord. *F.V.C.* False Vocal Cord. *L.S.* Laryngeal Saccule. *S.P.* Sinus Pyriformis. *A.E.F.* Aryteno-epiglottidean Fold.

cricoid in its postero-lateral part known as the *crico-thyroid articulation*, and another, the *crico-arytenoid articulation*, between the base of the arytenoid cartilage and the upper sloping border of the signet part of the cricoid.

Each of these joints has a definite capsule and synovial membrane, which, in the case of the crico-arytenoid articulation, is specially lax, in order that the arytenoids may glide towards and away from one another.

Now make a sagittal mesial section through the whole larynx and explore the *laryngeal saccule* with a seeker. After passing through the oval opening between the true and false cords the seeker may be pushed upwards for half to three-quarters of an inch, so that the secretion of the mucous membrane of the saccule must flow down over the true cords and keep them moist.

The *submucous tissue* of the larynx is plentiful except in two places, one at the back of the epiglottis and the other over the true vocal cords. Try to strip off the mucous membrane, and notice how closely it is bound down to the subjacent tissues in these regions. Elsewhere the mucous membrane can be raised with the greatest ease.

A practical point in connection with this is that in œdema of the larynx, such as is sometimes caused by a child trying to drink boiling water out of the spout of a kettle, the inflammatory exudation which is in the submucous tissue does not pass below the true vocal cords.

The *mucous membrane* of the upper part of the larynx is continuous with that of the pharynx, while below it is continuous with that of the trachea.

After the mucous membrane has been investigated the *cartilages* should be cleaned but not separated from one another. The thyroid, cricoid, and epiglottis will, of course, have been cut in half, but this matters little.

If these cartilages are drawn from different points of view, their shape and relations will soon be appreciated and remembered.

Notice especially the leaf-like shape of the epiglottis, the stalk of which is known as the *thyro-epiglottic ligament,* and is attached to the thyroid cartilage just above the anterior attachments of the true vocal cords.

This cartilage never ossifies, because it is made of fibro-cartilage, instead of hyaline, like the thyroid, cricoid, and arytenoids, all of which ossify as a rule in middle life.

The *cornicula laryngis*, or little cartilages, which project back on each side from the apices of the arytenoids, are made of fibro-cartilage, as are also the cuneiform cartilages already mentioned (p. 187), so that these too do not ossify.

PREVERTEBRAL REGION

A dissection has still to be made of that part of the neck and skull which was removed in order to see the pharynx from behind.

It has been noticed that this part of the neck is naturally divided from the part in front by the dense mass of woolly cellular tissue which can so easily be converted into a thick sheet by artificial methods.

Behind this tissue lie the prevertebral muscles, consisting of the longus colli, scalenus anticus, rectus capitis anticus major and minor.

The *longus colli* consists of a vertical and two oblique parts. The vertical part is nearest the middle line, and rises from the bodies of the upper three thoracic and lower three cervical vertebræ. It is inserted into the front of the bodies of the second, third, and fourth cervical vertebræ.

The lower oblique part rises just external to the last from the bodies of the upper three thoracic vertebræ, and is inserted into the anterior tubercles of the transverse processes of the fifth and sixth cervical vertebræ, while the upper oblique part rises from the anterior tubercles of the third, fourth, fifth, and sixth cervical transverse processes, and is inserted into the tubercle in the mid-ventral line of the atlas. On their way these fibres groove the anterior surface of the body of the axis.

In order to verify the lower part of the origin of the vertical and lower oblique parts, the thorax must be looked

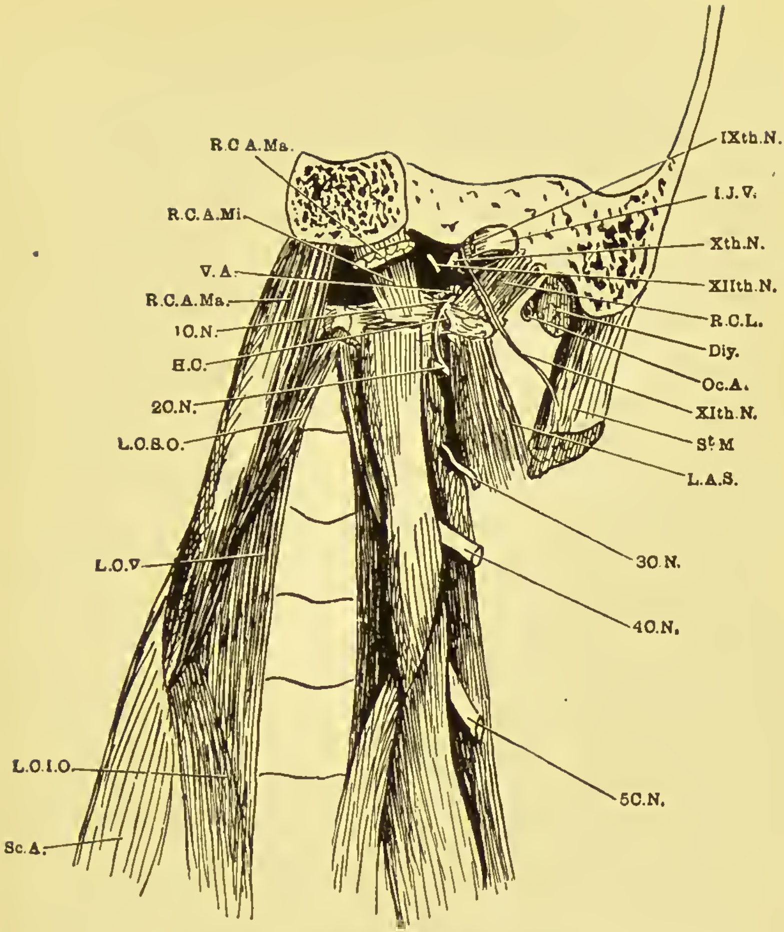


FIG. 108.—PREVERTEBRAL REGION.

R.C.A.Ma. Rectus Capitis Anticus Major. *R.C.A.Mi.* Rectus Capitis Anticus Minor. *V.A.* Vertebral Artery. 1 *C.N.* First Cervical Nerve forming a loop with 2 *C.N.* (the Second Cervical Nerve). 3 *C.N.*, 4 *C.N.*, 5 *C.N.* Other Cervical Nerves. *L.C.S.O.* Superior Oblique part of Longus Colli. *L.C.V.* Vertical part of Longus Colli. *L.C.I.O.* Inferior Oblique part of Longus Colli. *Sc.A.* Scalenus Anticus. *L.A.S.* Levator Anguli Scapulæ. *St.M.* Sterno-mastoid. *XIth N.* Spinal Accessory Nerve. *Oc.A.* Occipital Artery. *Dig.* Digastric. *R.C.L.* Rectus Capitis Lateralis. *XIIth N.* Hypoglossal Nerve. *Xth N.* Vagus Nerve. *I.J.V.* Internal Jugular Vein. *IXth N.* Glosso-pharyngeal Nerve.

at, since it is seldom possible to remove the neck below the disc between the first and second thoracic vertebræ.

The *scalenus anticus* [M. scalenus anterior] has already been studied, and most of its relations noticed (see p. 157). It will be seen now that its posterior relations are the subclavian artery (second part), the brachial plexus, and the scalenus medius.

The *rectus capitis anticus major* [M. longus capitis] rises from the same anterior tubercles of the cervical vertebræ to which the scalenus anticus and the upper oblique part of the longus colli are attached, namely, the third, fourth, fifth, and sixth cervical. It is interesting to notice how sharply all these prevertebral muscles stop at the carotid tubercle of the sixth cervical vertebra.

The insertion of the rectus capitis anticus major is into the basilar process of the occipital bone, outside and behind the pharyngeal spine.

Cut the last muscle and expose the *rectus capitis anticus minor* [M. rectus capitis anterior], rising from the lateral mass of the atlas in front of the articular facet, and running upwards and inwards, to be inserted into the basilar process of the occipital bone, just behind and a little internal to the insertion of the major muscle.

Between the anterior and posterior tubercles of adjacent cervical transverse processes are small *anterior* and *posterior intertransverse muscles*, which are of only the slightest practical importance.

The posterior set of these muscles, however, are continued up from the transverse process of the atlas by the *rectus capitis lateralis* muscle, which has already been noticed several times. It runs up to be inserted into the jugular process of the occipital bone, and it is well worth while spending a few minutes in reviewing its numerous and important relations.

On the outer side of the rectus capitis lateralis are the occipital artery and sometimes the spinal accessory nerve,

while, more superficially, is the posterior belly of the digastric (see Fig. 108).

In front are the internal jugular vein and vagus nerve, while the styloid process, with the muscles rising from it especially the stylo-pharyngeus, is very near.

Internally is the vertebral artery and the beginning of its vein, together with the anterior division of the first cervical nerve, and, more internally, the capsule of the occipito-atlantal joint.

Posteriorly is the obliquus capitis superior muscle (see Fig. 111, p. 246).

The Second Stage of the Vertebral Artery and the Cervical Nerves in relation to it

The first part of the vertebral artery was followed to the foramen in the transverse process of the sixth cervical vertebra, where it enters on its second stage.

The best way to get a good idea of the relations of the artery in this part of its course is to disarticulate the third from the fourth cervical vertebra, keeping as close to the former as possible and avoiding any injury to the fourth cervical nerve, the roots of which can be seen leaving the already-opened spinal canal (see Fig. 109).

The *vertebral vein* should be looked for on the outer side of the artery, though sometimes it breaks up into a plexus and surrounds the latter.

Carefully dissect out the nerve, following its two roots until they join, and notice how it passes behind the vertebral artery and vein and then divides at once into anterior and posterior primary divisions lying in the laterally directed trough, which the upper part of the transverse process forms.

Notice very carefully that in the intervertebral foramen, where the ganglion on the posterior root lies, the nerve passes in front of the articular processes.

Before the nerve is clear of the intervertebral foramen the anterior and posterior roots unite, and very soon after

this, behind the vertebral artery, the mixed nerve divides

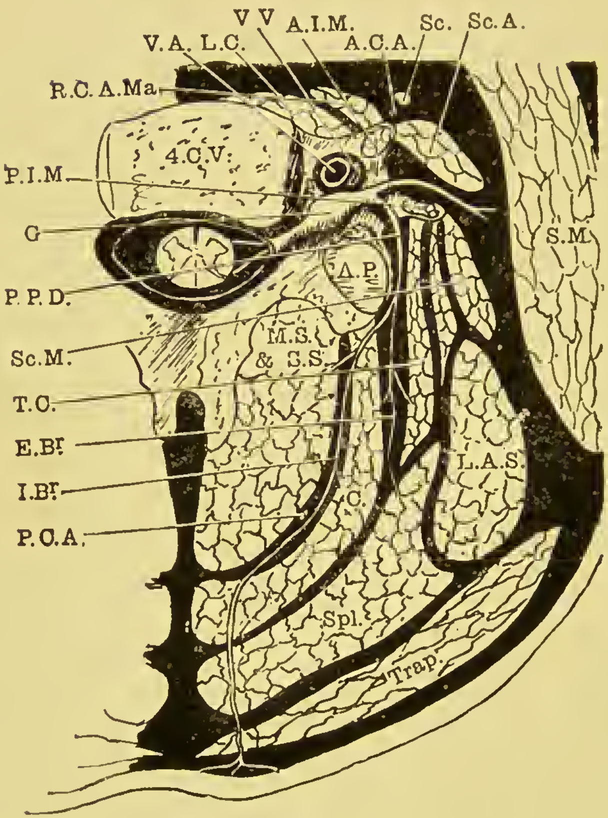


FIG. 109.—DIAGRAMMATIC SECTION THROUGH THE BACK OF THE RIGHT SIDE OF THE NECK TO EXPOSE THE COURSE OF THE POSTERIOR DIVISION OF THE FOURTH CERVICAL NERVE.

4 *C.V.* Body of Fourth Cervical Vertebra. *L.C.* Longus Colli. *R.C.A.Ma.* Rectus Capitis Anticus Major. *V.A.* Vertebral Artery. *V.V.* Vertebral Vein. *A.I.M.* Anterior Intertransverse Muscle. *P.I.M.* Posterior Intertransverse Muscle. *A.C.A.* Ascending Cervical Artery. *Sc.* Sympathetic. *Sc.A.* Scalenus Anticus. *S.M.* Sterno-mastoid Muscle. *G.* Posterior Root Ganglion in its Sheath. *P.P.D.* Posterior Primary Division of Fourth Cervical Nerve. *Sc.M.* Scalenus Medius. *T.C.* Transversalis Colli. *E.Br.* External Branch of Nerve. *I.Br.* Internal Branch of Nerve. *P.C.A.* Profunda Cervicis Artery. *A.P.* Articular Process. *M.S.* and *S.S.* Multifidus and Semispinalis. *C.* Complexus. *Spl.* Splenius. *L.A.S.* Levator Anguli Scapulæ. *Trap.* Trapezius.

into its anterior and posterior primary divisions, of which the

posterior runs backwards before the posterior intertransverse muscle is reached, while the anterior continues its course outwards between the intertransverse muscles.

If the injection is good a spinal branch may be seen running inwards to the spinal canal from the vertebral artery, while other small twigs run forwards to anastomose with the ascending cervical artery in front of the transverse processes, backwards to the profunda cervicis behind them, and outwards to the origins of the muscles of the posterior triangle.

In dissecting the suboccipital triangle (Fig. 111), it was seen that the first nerve passed behind the occipito-atlantal articulation, and, if the course of the second cervical is followed, it too will be seen to pass behind the atlanto-axial articular facets, so that these two are exceptions to the general course of the spinal nerves.

The whole course of the second part of the vertebral artery may be laid bare by snipping away the transverse processes on one side, and it will be noticed how the artery turns outwards after leaving the vertebrarterial canal in the axis on its way to reach that of the atlas.

THE JOINTS OF THE NECK

An examination of the separated surfaces of the third and fourth cervical vertebræ will give a very good idea of the means by which the lower six cervical vertebræ are joined together.

Between the centra is the *intervertebral disc* [fibro-cartilago intervertebralis], a dense mass of fibrous tissue which binds together the two cartilage-covered surfaces.

If a coronal section is made through two of the centra lower down, it will be noticed that where the upturned lateral lip (neuro-central lip) comes into contact with the body of the vertebra above, a small synovial cavity is formed, which is a peculiarity of the cervical region (Fig. 112).

When two cartilage-covered bones are united by the fibrous tissue, as the centra are by the intervertebral disc, the resulting joint is called a symphysis or amphiarthrosis, but when a synovial cavity intervenes, as it does between the neuro-central lips and the body of the vertebra above, the joint is known as a diarthrosis.

Now look at the separated articular processes between the third and fourth vertebræ, and notice how each is surrounded by a loose capsule lined on its inner surface by synovial membrane. These, because they have a synovial membrane, are classified as diarthrodial joints, and, because they only allow a gliding movement, belong to the gliding or arthrodial subdivision of the diarthroses.

Between the laminæ are the *ligamenta subflava*, but as these have been cut away the dissector must recall the experience he gained of them in exposing the spinal cord (see p. 19).

Remove the longus colli and recti capitis muscles from the front of the upper three cervical vertebræ, and notice that the *anterior common ligament* [lig. longitudinale anterius] is continued up to the longus colli tubercle on the front of the atlas, and, after being firmly attached there, goes on to the under surface of the basilar process as the median part of the *anterior occipito-atlantal ligament* [membrana atlanto-occipitalis anterior]. Now turn the specimen round and look at it from behind. The posterior arch of the atlas has been removed in tracing the spinal cord up to the foramen magnum, and, while removing it, the *posterior occipito-atlantal ligament* joining it to the posterior margin of the foramen magnum and pierced by the vertebral arteries was noticed (see p. 17).

Follow up the *posterior common ligament* [lig. longitudinale posterius] connecting the backs of the centra (see p. 32) to the back of the centrum of the axis, and notice how it is prolonged up to join the periosteum or cranial layer of the dura mater on the upper surface of the basilar process of

the occipital bone. This upward prolongation is known as the *posterior occipito-axial ligament* [membrana tectoria], and it will easily be understood how this probably represents the prolongation downwards into the spinal canal of the cranial

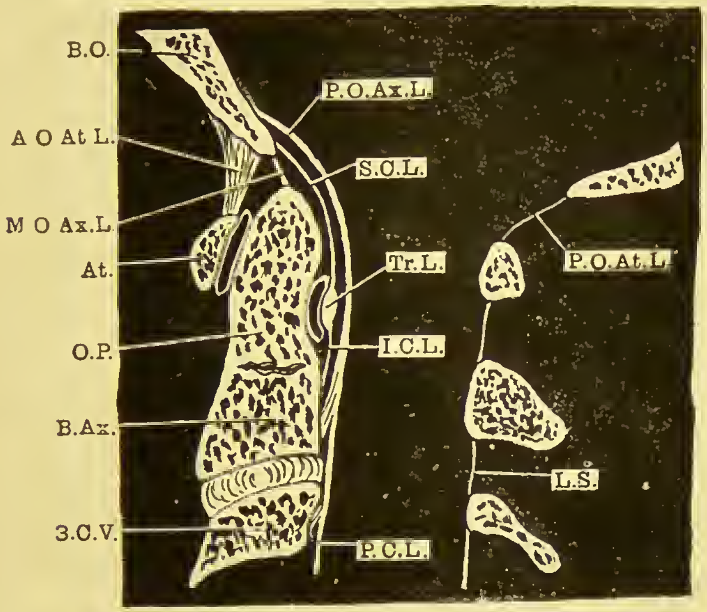


Fig. 110.—Sagittal Section through the Occipital Bone, Atlas and Axis to show the Articulations.

B.O. Basi-occipital. *A.O.At.L.* Anterior Occipito-atlantal Ligament. *M.O.Ax.L.* Middle Occipito-axial Ligament. *At.* Atlas. *O.P.* Odontoid Process. *P.O.Ax.L.* Posterior Occipito-axial Ligament. *Tr.L.* Transverse Ligament. *S.C.L.* Upper Part of Crucial Ligament. *I.C.L.* Lower Part of Crucial Ligament. *P.C.L.* Posterior Common Ligament. *P.O.At.L.* Posterior Occipito-atlantal Ligament. *L.S.* Ligamentum Subflavum.

layer of the dura mater of the skull lining the clivus and adjacent parts.

Cut this ligament and turn its ends up and down; by so doing its attachments may be verified more carefully.

When this is done the *transverse ligament* [lig. transversum atlantis] is brought into view—a most important ligament, because it acts as a strap which is attached to the

lateral mass on each side of the atlas and passes behind the odontoid process, keeping that close to the anterior arch of the atlas. It is very strong and thick, as it need be considering its important function. Sometimes, though not

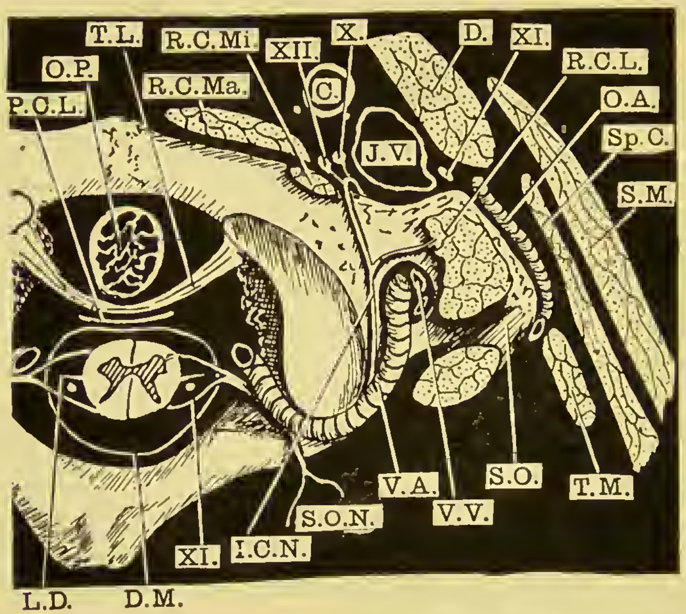


Fig. 111.—Diagram of the Atlas and its Relations seen from above.

O.P. Odontoid Process. *T.L.* Transverse Ligament. *P.C.L.* Posterior Common Ligament. *R.C.Ma.* Rectus Capitis Anticus Major. *R.C.Mi.* Rectus Capitis Anticus Minor. *C.* Internal Carotid Artery. *J.V.* Internal Jugular Vein. *XII.* Hypoglossal Nerve. *X.* Vagus Nerve. *XI.* Spinal Accessory Nerve. *R.C.L.* Rectus Capitis Lateralis. *O.A.* Occipital Artery. *Sp.C.* Splenius Capitis. *S.M.* Sterno-mastoid. *T.M.* Trachelo-mastoid. *S.O.* Superior Oblique Muscle. *V.V.* Vertebral Vein. *V.A.* Vertebral Artery. *S.O.N.* Suboccipital Nerve. *I.C.N.* First Cervical Nerve (Anterior Primary Division). *D.M.* Dura Mater. *L.D.* Ligamentum Dentatum.

always, a band passes up from the middle of it to the basilar process, while another always passes down to the back of the centrum of the axis. When these vertical bands are present the whole structure forms a cross, and is known as the *crucial ligament* [lig. cruciatum atlantis] (see Fig. 110).

The *accessory atlanto-axial ligaments* should now be looked for running obliquely from the atlas, just behind the lateral attachments of the transverse ligament, to the back of the centrum of the axis, to the capsule of which they give support.

When the upper limb of the crucial ligament is cut the odontoid process will come into view, and from both sides of its conical tip the *alar or check ligaments* [ligg. alaria] are seen running horizontally outwards to the tubercles on the inner surfaces of the occipital condyles. These are the ligaments by which the whole weight of the body is suspended from the head when a child is lifted up by its chin and occiput; they also greatly strengthen the occipito-atlantal joints, which are otherwise not very strong.

Passing up from the very apex of the odontoid process to the anterior edge of the foramen magnum is the *middle check ligament* [lig. apicis dentis], feeble, sometimes absent, and never of any practical importance, yet of considerable morphological interest, because in it lie the remains of the notochord and its sheath.

It may be worth while, before leaving them, to review these median ligaments, this time from before backwards:—

1. Most anteriorly is the median part of the anterior occipito-atlantal ligament, the upward continuation of the anterior common ligament (see Fig. 110).
2. The middle check ligament.
3. The upper limb of the crucial ligament.
4. The posterior occipito-axial ligament.
5. Behind the spinal cord, the posterior occipito-atlantal ligament.

Now make a coronal section passing across the body of the third cervical vertebra, the body of the axis, the odontoid process and the articulations between the atlas and the occipital bone.

This will show that the little synovial spaces between the neuro-central lips of the third cervical body and the adjacent

part of the body of the axis are in the same vertical plane, and probably correspond to the articulations between the atlas and axis and occipital condyles and atlas.

It will also show that the disc between the third cervical

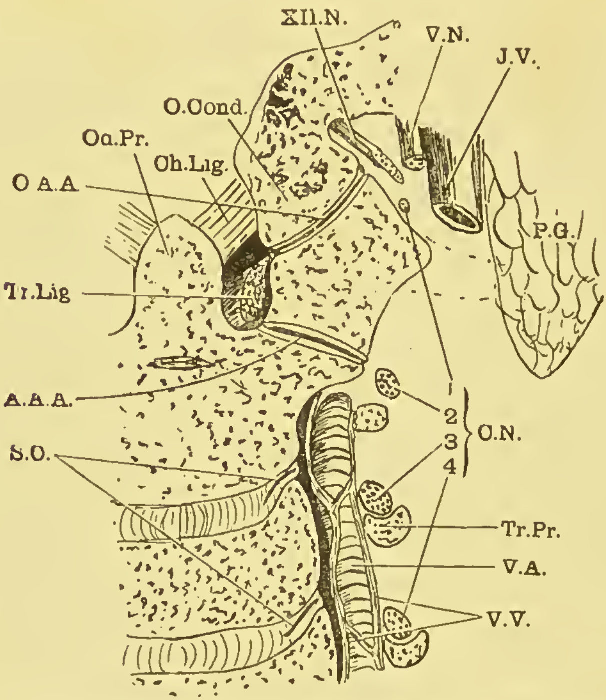


Fig. 112.—Coronal Section through the Upper Cervical Vertebræ (seen from in front).

Od.Pr. Odontoid Process. *Ch.Lig.* Lateral Check Ligaments. *O.Cond.* Occipital Condyle. *XII.N.* Hypoglossal Nerve. *V.N.* Vagus Nerve. *I.V.* Internal Jugular Vein. *P.G.* Parotid Gland. *O.A.A.* Occipito-atlantal Articulation. *Tr.Lig.* Transverse Ligament. *A.A.A.* Atlanto-axial Articulation. *S.C.* Synovial Cavities between the Lateral Parts of the Cervical Centra. 1, 2, 3, 4 *C.N.* Respective Cervical Anterior Primary Nerve Divisions. *Tr.Pr.* Transverse Process. *V.A.* Vertebral Artery. *V.V.* Vertebral Vein Plexus.

vertebra and axis is very small—indeed, the smallest of all the discs—while that between the atlas and axis is only represented by a little cleft containing some cartilage, usually seen in this section at the base of the odontoid process and between it and the body of the axis.

When the shape and direction of these joint surfaces have been studied on the dry bones it will be evident that those between the occiput and atlas are adapted to a nodding movement of the head, while those between the atlas and axis act as guides in the rotatory movement of shaking the head which occurs here, and to which the odontoid process of the axis acts as a pivot.

This atlo-axial joint should now be examined, since, although the section has passed transversely through it, the parts may easily be replaced. Notice how the convex articular surface on the front of the odontoid process fits against the facet on the anterior arch of the atlas, and how the back of the odontoid process becomes somewhat constricted to form a neck where the transverse ligament rests against it. Notice, too, that there is a synovial capsule in front of and behind the odontoid process, but none at the sides. This atlo-axial joint is a good example of the pivot, trochoid or lateral ginglymus variety of the diarthrodial joints.

THE EAR

The ear is divided into three parts—external, middle, and internal. A knowledge of the topography of these is essential to the study of the physiology of hearing, but, in addition to this, the parts are so liable to disease, and so frequently the site of surgical interference, that, although this is usually the last part of the head and neck to be dissected, its examination should on no account be neglected or hurried over.

As in the study of the brain, the dissectors of opposite sides should agree to work together and adopt different methods of exposing the two sides.

The pinna has already been studied before it dried up (see p. 56), so that the external auditory meatus is the part to begin with.

External Auditory Meatus [meatus acusticus externus].—On looking into this tube, its general direction will be seen

to be inwards and forwards, though its whole length cannot be seen, because its floor rises for some distance and then sinks. Moreover, although the forward and inward direction is maintained in the greater part of its course, it takes a slight curve backwards and inwards about its middle.

If in the living subject the pinna be pulled upwards and backwards, the tube is straightened out, and then with an aural speculum and mirror the outer surface of the tympanic membrane, as well as the whole length of the canal, may be examined. In the dead body, however, it may be studied more completely by splitting it longitudinally.

Since the outer part of the meatus is fibro-cartilaginous, a vertical incision should first be made along its middle until the knife is stopped by the bone; then localise the internal auditory meatus and make a vertical saw-cut from the middle of the external to the middle of the internal auditory meatus.

A fine saw should be used; indeed, the writer generally uses a fret-saw on account of the small amount of damage it does to the soft parts.

The bone should be held upside down while it is being cut, and the line should pass just behind the carotid canal and in front of the internal jugular vein. In this way, by watching the saw carefully to see that it goes through the middle of each meatus, a very valuable section will be made.

It is a mistake to saw off the squamous part of the temporal before making the section, as this acts as a valuable guide in putting the parts into their proper positions afterwards.

Now look at the external auditory meatus and notice that it is about an inch long, two-thirds bony and one-third cartilaginous. Its floor is rather longer than its roof, owing to the obliquity of the tympanic membrane, and the whole canal is lined with skin, which in the outer part has hairs growing from it, while large brownish ceruminous glands secrete the wax with which the passage is often blocked.

Supposing that this section has been made on the right

ear, the left should now be taken, and two or three transverse sections made through the cartilaginous part of the meatus.

These show that the meatus is oval in section and

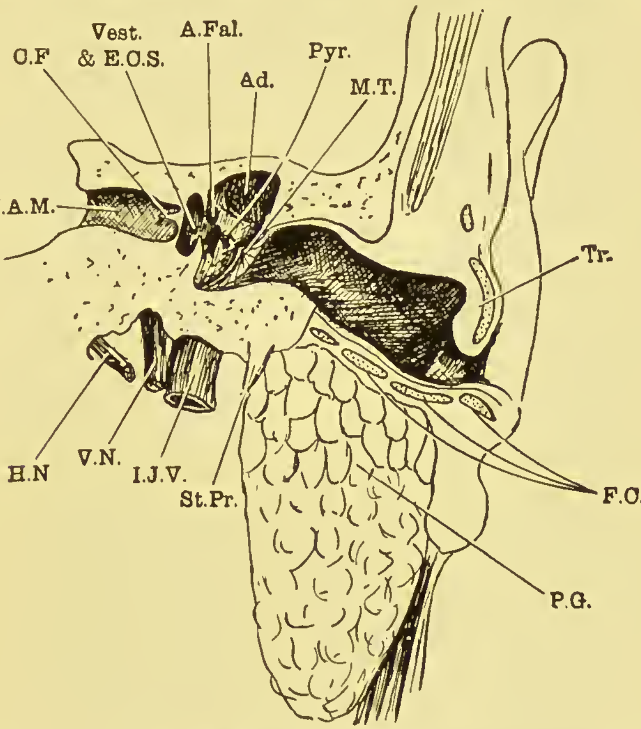


Fig. 113.—Coronal Section through the External and Internal Auditory Meatus.

P.G. Parotid Gland. *F.C.* Fibro-cartilage. *St.Pr.* Base of Styloid Process. *I.J.V.* Internal Jugular Vein. *V.N.* Vagus Nerve. *H.N.* Hypoglossal Nerve. *I.A.M.* Internal Auditory Meatus. *C.F.* Crista Falciformis. *Vest. & E.C.S.* Vestibule and Opening of External Semicircular Canal. *A.Fal.* Aqueductus Fallopii. *Ad.* Aditus. *Pyr.* Pyramid. *M.T.* Membrana Tympani. *Tr.* Tragus.

diminishes slightly in size until the junction between the cartilaginous and bony parts is reached, so that this is a common place for a foreign body to stop.

They also show that the cartilage surrounding the meatus is much less complete above than below, and that the parotid

gland is in contact with the floor of the cartilaginous part of the tube (see Fig. 113).

THE TYMPANIC MEMBRANE [membrana tympani].—The section on the right side has passed through the tympanic membrane, but it is easy to see that the tympanic ring on which it is stretched is obliquely placed, the lower part being nearer the mid line than the upper (Fig. 113).

In order to get a good view of the outer surface of the membrane the left bone should be taken, and the antero-inferior wall of the bony meatus cut away with chisel and forceps. By far the best implement for this purpose is the parrot-bill forceps, a pair of which should be in every well-equipped dissecting-room.

Notice that the bone which has just been removed is the tympanic plate, and that in front of it the parotid gland rests. Sometimes, though not very often in the adult, this plate is perforated, as it always is in childhood up to about the sixth year.

Now look at the outer surface of the membrane, and notice that it is not only oblique from above downwards, but from before backwards, its anterior end being nearer the middle line of the body than its posterior. If a third ear is available a horizontal section should be made from the external to the internal meatus. This shows the obliquity of the membrane just mentioned very well (see Fig. 114). In the child the membrane is more horizontal and a good deal nearer the surface of the head.

The membrane is slightly concave at its centre, which is known as the *umbo*, while running downwards and a little backwards to this point the handle of the malleus can be seen through the semi-transparent structure. Behind and parallel to this the long process of the incus may sometimes be made out indistinctly.

At the upper and front part of the membrane, where the root of the handle of the malleus lies, a little knob of bone is seen pushing against the inner surface of the membrane and

causing it to bulge a little. This is the short process [processus lateralis] of the malleus, and just above it is a small triangular area with its base upwards and its apex at the

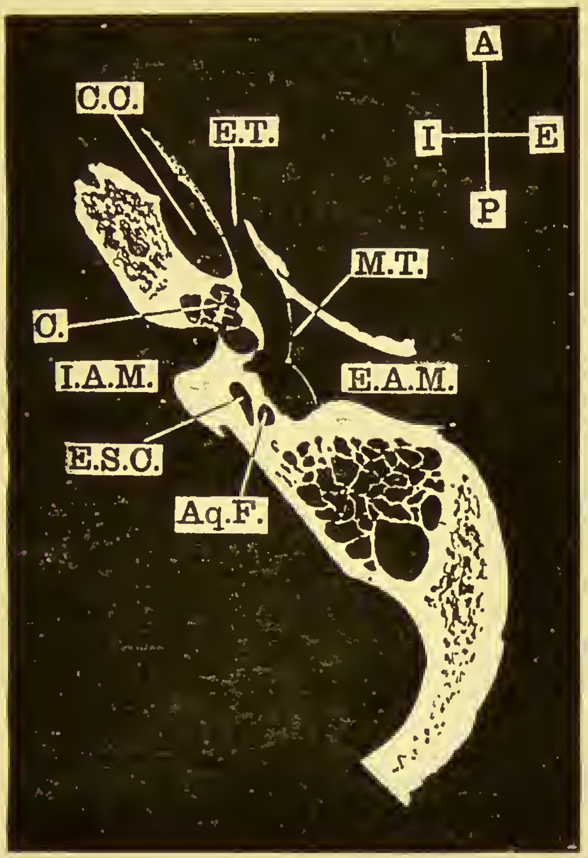


Fig. 114.—Horizontal Section of the Right Ear passing through the External and Internal Auditory Meatus.

E.A.M. External Auditory Meatus. *I.A.M.* Internal Auditory Meatus. *M.T.* Membrana Tympani, internal to which is the Tympanum. *Aq.F.* Aqueduct of Fallopius. *E.S.C.* External Semicircular Canal. *C.* Cochlea. *C.C.* Carotid Canal. *E.T.* Eustachian Tube.

short process, where the membrane is loose, and so is known as the *membrana flaccida* (Shrapnell's membrane).

The postero-inferior quadrant of the membrane, *i.e.* the part below and behind the umbo, was the place where

incisions used to be made when it was necessary to drain the middle ear, though now aural surgeons take the incisions higher.

Although it cannot be demonstrated in the dissecting-room, it is important to remember that the membrane consists of three layers—the outer skin, the middle fibrous tissue, and the inner, the mucous membrane lining the tympanum.

The Middle Ear

The Tympanum, Mastoid Antrum, and Mastoid Cells.—The section which has been made on the right side passes across the *tympanum* or *middle ear*, and it will be at once appreciated, on looking at it, what a narrow, slit-like cavity this is (Fig. 113).

From the tympanic membrane to the inner wall is only about one-sixth of an inch at its narrowest, and the cavity is much narrower below than above, although the narrowest point is between the promontory (see later) and the umbo about two-thirds of the way down (Fig. 115).

The height, however, is more than half an inch, and it will be noticed that the membrane only occupies about the lower two-thirds of the outer wall.

That part of the cavity which lies above the level of the top of the membrane is known as the *attic*, and its roof is a thin plate of compact bone called the tegmen tympani, which separates it from the middle cranial fossa.

It is important to realise that the roof of the attic is continuous with that of the antrum.

A fine seeker passed forwards will traverse the bony part of the Eustachian tube which opens from the front of the tympanum, while if the seeker is pushed backwards from the attic it goes through another opening, known as the *aditus*, into the mastoid antrum (see Fig. 113).

The floor of the tympanum is divided by an extremely thin plate of bone from the jugular fossa (containing the

jugular bulb) posteriorly and the carotid canal anteriorly, the section having passed just between the two.

To see more of the tympanum, it should be divided longitudinally by a vertical cut.

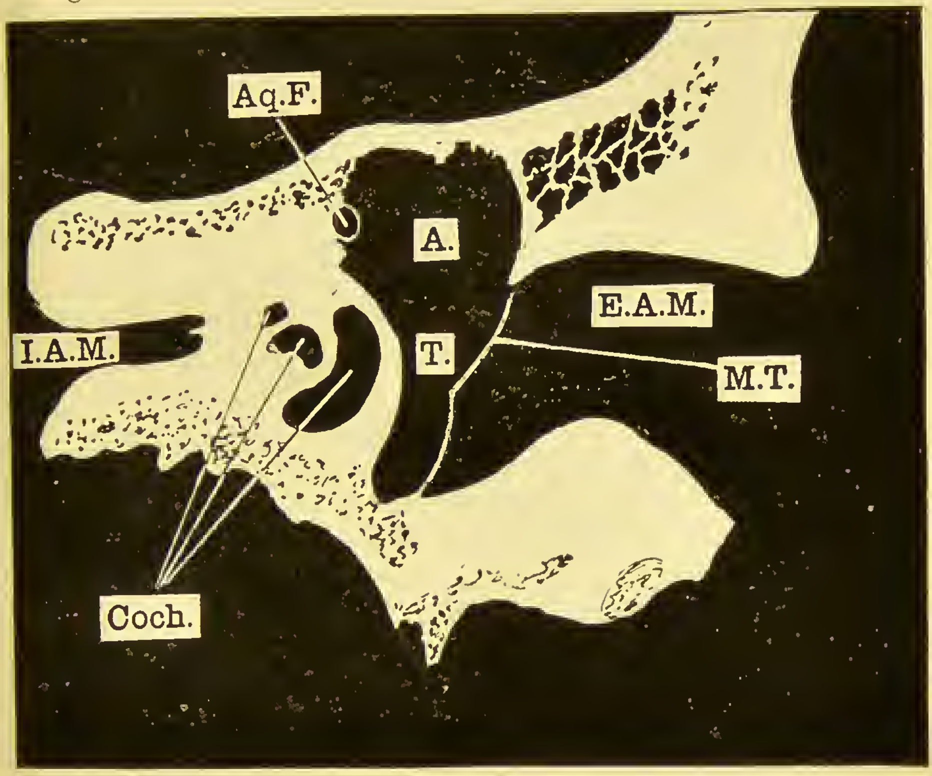


Fig. 115.—Coronal Section of the Tympanum through the Promontory.

T. Tympanum. *A.* Attic. *Aq.F.* Aqueductus Fallopii. *M.T.* Membrana Tympani. *E.A.M.* External Auditory Meatus. *I.A.M.* Internal Auditory Meatus. *Coch.* Cochlea and a small part of the Vestibule.

Take the left bone and localise the Eustachian tube, the lower opening of the carotid canal, and the stylo-mastoid foramen, whence the seventh nerve is emerging. Holding the bone upside down, mark out a line passing through the middle of the opening of the bony part of the Eustachian tube, back through the outer part of the carotid canal and

jugular fossa internal to the root of the styloid process, and so to the stylo-mastoid foramen. Behind that it will pass through the digastric fossa of the mastoid process.

It will be more satisfactory if these points are first localised on a dry temporal bone of the same side, and then the line determined in the moist specimen.

Still holding the bone upside down, cut along this line with a fret-saw, making the cut as vertical as possible.

If a vice is obtainable, it makes things much easier to fix the squamous part of the temporal in that; but if this is not available, the other dissector must help to steady the bone.

When this section is made, the antero-posterior extent of the tympanum is seen to be about the same as its height, that is, rather more than half an inch (see Fig. 116).

The tympanum may now be pictured as a somewhat circular vertical slit lying in the petrous bone between the outer and inner ears, the diameter being about half an inch, while the breadth is only one-sixth of an inch below. For convenience of description a narrow roof and floor may be recognised, a narrow anterior and posterior wall, and an extensive external and internal wall. Of these the roof and floor have been studied.

The outer wall is seen in the section just made; the tympanic membrane occupies the greater part of it, but above and behind is the attic, the outer wall of which is the bone at the root of the zygoma. In this attic the head of the malleus and the greater part of the incus are lying; at least these two bones usually come away with the outer half of the section, while the stapes remains attached to the inner wall (Fig. 116).

Between the handle of the malleus and the long process of the incus the *chorda tympani nerve* is seen running forward to a small opening in front of the upper part of the tympanic ring; this is the *iter chordæ anterius*, and it lies just on the outer side of the tympanic opening of the Eustachian tube.

A little behind it, and more over the top of the tympanic ring, is the *Glaserian fissure* through which the *anterior ligament of the malleus* passes, as well as the tympanic branch of the internal maxillary artery, and into which the processus gracilis of the malleus may be traced.

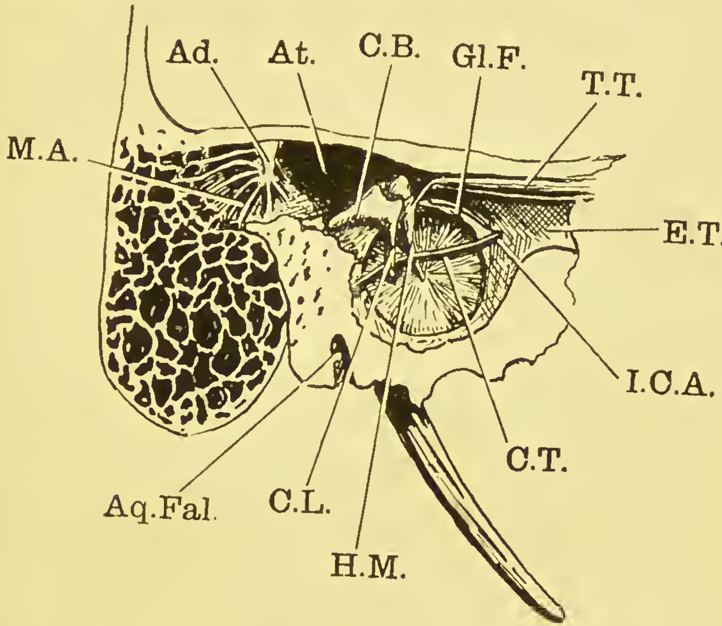


FIG. 116.—OUTER WALL OF LEFT TYMPANUM.

E.T. Eustachian Tube. *T.T.* Tensor Tympani Muscle. *Gl.F.* Glaserian Fissure. *H.M.* Handle of Malleus. *C.L.* Crus Longum of Incus. *C.B.* Crus Breve of Incus. *C.T.* Chorda Tympani Nerve. *I.C.A.* Iter Chordæ Anterius. *Aq.Fal.* Opening of Aqueductus Fallopii. *At.* Attic. *Ad.* Aditus. *M.A.* Mastoid Antrum.

For the inner wall of the tympanum, the other half of the section of the left bone must be studied (Fig. 117).

Directly opposite the tympanic ring and membrane is a convexity known as the *promontory.* On its surface are some delicate grooves for the nerves of the *tympanic plexus* formed by the branching of Jacobsen's nerve (tympanic branch of the glosso-pharyngeal), which comes from the petrous ganglion of the ninth cranial nerve and enters the

tympanum through a foramen on the wall between the jugular fossa and carotid canal. Of course this plexus is embedded in the mucous membrane covering the promontory, but its larger branches may sometimes be seen without interfering with this in any way. This is the more easy during life, as a small vessel accompanies the nerve.

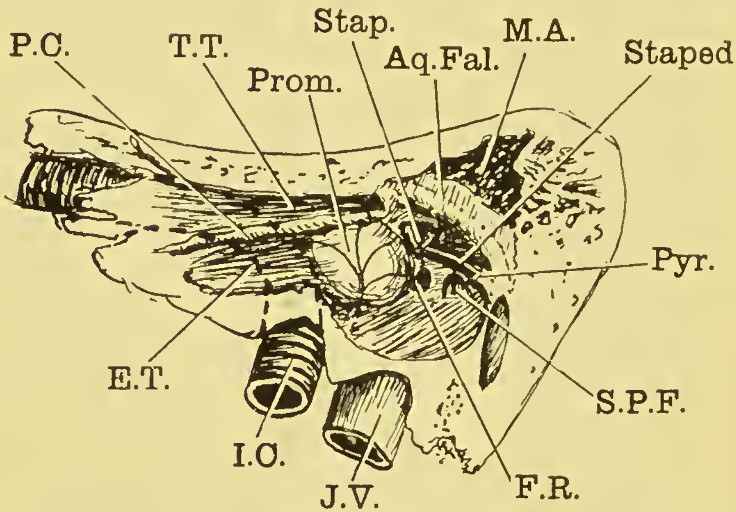


FIG. 117.—INNER WALL OF THE LEFT TYMPANUM.

P.C. Processus Cochleariformis. *T.T.* Canal for Tensor Tympani. *Prom.* Promontory with Tympanic Plexus upon it. *E.T.* Eustachian Tube. *I.C.* Internal Carotid Artery passing into the Carotid Canal (dotted). *J.V.* Internal Jugular Vein. *Stap.* Stapes fixed in Fenestra Ovalis. *Aq.Fal.* Ridge formed by Aqueductus Fallopii lying to the inner side of the Aditus which leads into *M.A.*, the Mastoid Antrum. *Staped.* Stapedius Tendon coming out of *Pyr.*, the Pyramid. *S.P.F.* Subpyramidal Fossa. *F.R.* Fenestra Rotunda.

The most important branch of the plexus is the *small superficial petrosal nerve*, which leaves the tympanum just above the promontory and reappears in the middle cerebral fossa, where it has already been looked for on its way to the otic ganglion (see p. 81).

Above the posterior part of the promontory is the *fenestra ovalis* [f. vestibuli], a small kidney-shaped aperture, situated

in a depression, in which the footplate of the stapes will almost certainly be found fitting in one at least of the two sections, bound to the margins of the opening by the *annular membrane.*

Above the fenestra ovalis, and therefore still more above the promontory, is the *aqueduct of Fallopius* [canalis facialis], containing the facial nerve; it forms a ridge, the wall of which is so thin that the nerve can be seen through it. As it is lying above the fenestra ovalis, it, together with the external semicircular canal, forms the inner boundary of the aditus or opening into the mastoid antrum.

This relationship is most important, and must be borne in mind in any operative interference, such as using a sharp spoon in this neighbourhood.

The immense difference between the practical importance of a structure like the tympanic plexus, on the one hand, and the aqueduct of Fallopius with its facial nerve, on the other, cannot be too strongly impressed upon the student. Ignorance or forgetfulness of the former matters little, but ignorance or forgetfulness of the latter may mean facial paralysis to the patient.

Just behind the fenestra ovalis the aqueduct turns down, and now becomes embedded in the posterior wall of the tympanum.

Below and behind the promontory, and directly below the fenestra ovalis, is the *fenestra rotunda* [f. cochleæ], closed by the *secondary membrane of the tympanum.*

The anterior wall of the tympanum has, as has been seen, the bony part of the Eustachian tube opening from it. If the inner half of the left side be looked at, it will be seen that there is a thin plate of bone which separates the Eustachian tube from a small canal above it. This plate is the *processus cochleariformis,* and, when undamaged, stretches back above the promontory, nearly as far as the fenestra ovalis (see Fig. 117).

In the small canal above it lies the *tensor tympani*

muscle, which rises from the rough area near the apex of the inferior surface of the petrous bone, and its tendon, turning outwards round the posterior free end of the processus cochleariformis, runs outwards across the tympanum, to be inserted into the root of the handle of the malleus.

It will thus be seen that two tubes run forwards from the tympanum ; the upper small one for the tensor tympani, and the lower large one the Eustachian tube.

Measure the bony part of the tube, and notice that it is rather less than half an inch long. Its floor is formed by the tympanic plate, and just internal to it lies the carotid canal (see Fig. 114, horizontal section).

It is continued forwards into the cartilaginous part of the tube, which has already been noticed, but now may be studied in longitudinal section; it is rather more than twice as long as the bony part, so that the whole tube is about 1¾ inch long.

This cartilaginous part is a vertical slit, increasing rapidly in depth as the pharynx is approached. A transverse section of it will show that its roof and inner wall are cartilaginous, while its outer wall and floor are fibrous.

Through it the mucous membrane of the pharynx is continuous with that of the tympanum, and, as long as it is patent, air passes through it and equalises the atmospheric pressure on the two sides of the tympanic membrane.

When it becomes blocked, owing to acute or chronic inflammation of its mucous membrane, the air in the tympanum is absorbed and the tympanic membrane is bulged in by the pressure of the atmosphere outside it. This state of things, unless relieved, leads to permanent deafness.

Notice that the tympanic opening of the tube is considerably above the level of the floor of the tympanum.

In the posterior wall of the tympanum the most important thing is the opening from the attic into the mastoid antrum.

This *aditus* is an oval slit, with its long axis nearly vertical, and measuring about a quarter of an inch. Both it and the antrum, into which it leads, lie just below the tegmen tympani, and so may be easily opened up from the

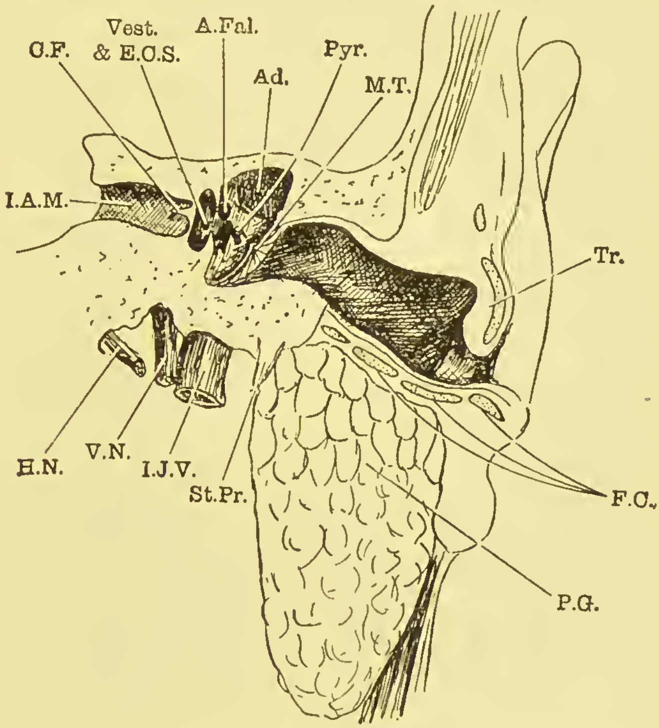


FIG. 118.—SECTION THROUGH THE PAROTID GLAND TO SHOW ITS CLOSE RELATIONSHIP TO THE EXTERNAL AUDITORY MEATUS.

P.G. Parotid Gland. *F.C.* Plates of Fibro-cartilage. *St.Pr.* Root of Styloid Process. *I.J.V.* Internal Jugular Vein. *V.N.* Vagus Nerve. *H.N.* Hypoglossal Nerve. The key to the other figures will be found on p. 251.

middle fossa of the cranium. It is worth noting that if, in the middle cranial fossa of a dried skull, a line is drawn from an eighth of an inch internal to the notch between the petrous and squamous parts of the temporal bone, where the spine of the sphenoid fits in, backwards and outwards to the most posterior point of the squamous bone, where it forms

a notch with the mastoid, this line will correspond in its anterior half-inch to the Eustachian tube, in the second half-inch to the tympanum, while in the third half-inch it lies over the antrum. This line corresponds very closely to the position of the petro-squamous suture in the child's skull, a suture which sometimes persists in the adult.

It is of clinical importance to notice that the aditus opens close to the roof of the antrum, and is therefore not a very efficient drain to that cavity.

In the posterior third of this line, chisel through the tegmen tympani, which is very thin, and expose the whole extent of the *mastoid antrum.* This cavity, of course, varies somewhat in size, and may perhaps be most happily compared to a wide-mouthed flask, the long axis of which is continuous with that of the tympanum and Eustachian tube. It is usually described as capable of containing a large pea, though the pea would have to be forcibly moulded into it; it is, however, very difficult to estimate its size properly owing to the fact that its walls are so richly sculptured with a network of bars and ridges of bone. These, in their turn, gradually fade away into the air-containing cancellous tissue of the mastoid process.

Now put the two halves of the right ear together and find the *suprameatal triangle* just above and behind the margin of the bony external auditory meatus; it varies a good deal in different skulls, but when well marked forms a very definite little triangular fossa, in the basal wall of which a sharp *suprameatal spine* overhangs the edge of the meatus. This spine may often be felt in the living head by putting the tip of the index finger into the external auditory meatus and pressing upwards and backwards. Even if it is not sufficiently well developed to be felt, the edge of the bony meatus can be made out and the site of the triangle localised.

Having made out the position of the triangle, clear the soft parts away from the bone by one sweeping downward cut, and drill directly inwards from the bottom of the triangle,

or, if it is absent, from just above and behind the margin of the bony meatus.

After drilling for about a quarter of an inch, the point of the drill or fine bradawl should be looked for in the mastoid antrum, though sometimes the bony wall is a good deal more than this in thickness.

The *mastoid cells* occupy the whole of the mastoid

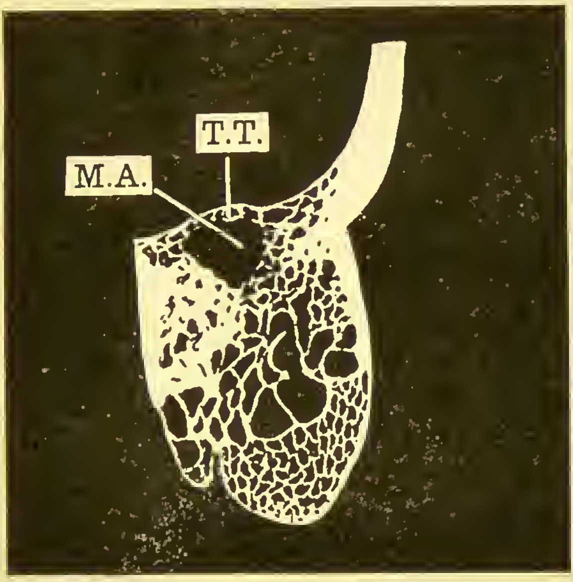


FIG. 119.—CORONAL SECTION THROUGH THE MASTOID PROCESS OF A YOUNG ADULT MALE SKULL SHOWING THE TEGMEN TYMPANI (*T.T.*) AND THE MASTOID ANTRUM (*M.A.*).

(The marrow-containing cells near the apex are quite distinct from the large air-containing cells above them.)

process, which has only a very thin coating of compact bone.

In the upper part they communicate with the antrum and are not very large, but as the middle of the process is approached they usually increase in size.

They are lined by an extension of the mucous membrane of the tympanum and antrum, and are filled with air from these cavities.

The cells near the apex of the process are much smaller than those above during early life, and do not communicate with them at all, since they contain marrow instead of air and represent the unaltered diploe of the cranial bones.

Below the aditus on the posterior wall of the tympanum is the continuation of the ridge formed by the aqueductus Fallopii. This has already been seen lying along the inner border of the aditus, but as it curves downwards and backwards it runs outwards a little as well.

When it reaches the posterior wall it no longer forms an elevation, but is quite embedded in the bone between the tympanum and the mastoid cells, and here it is surrounded by walls of ivory-like density, so that the facial nerve is little liable to accidental injury in interfering with this part of the tympanum.

In the lower part of the longitudinal section the aqueduct will probably be opened up, since the saw-cut passed through the stylo-mastoid foramen (see Fig. 117).

A little distance behind the fenestra ovalis the *pyramid* projects forwards from the posterior tympanic wall; it may have been damaged in the antero-posterior section, but will certainly be unharmed in the transverse one made on the right side. It is a small hollow cone, through the apex of which the *stapedius* tendon comes out and runs forwards to be inserted into the neck of the stapes, or, in other words, into that part of the stirrup which receives the stirrup leather.

Just below the pyramid and behind the fenestra rotunda is a little pit, which is known as the *sub-pyramidal fossa* or *sinus tympani*, and lies in the hollow of the posterior semicircular canal.

The *iter chordæ posterius*, through which the chorda tympani comes out of the aqueduct of Fallopius into the tympanum, lies just behind the posterior border of the tympanic membrane, between it and the outer side of the pyramid.

The Auditory Ossicles consist of the malleus, incus,

and stapes, which form a chain across the tympanum from the tympanic membrane to the fenestra ovalis. In the transverse section through the two meatus the malleus is often displaced, but in the antero-posterior section the malleus and incus are hardly ever disturbed in the outer half of the section, while the stapes remains engaged in the fenestra ovalis in the inner half.

The *malleus* (see Fig. 116, p. 257) has a knob-like *head* [capitulum mallei], which lies in the attic above the level of the membrana tympani ; behind this it has a facet for articulation with the incus. The *neck* [collum mallei] lies on a level with the top of the membrane, and is continued into the *handle* [manubrium mallei], which runs downwards and a little backwards to the umbo. From the outer side of the neck the *short process* [p. lateralis] projects, and, as has been seen, presses against the lower part of the membrana flaccida. The *long* or *slender process* [p. anterior] is a delicate spicule of bone which projects into the Glaserian fissure from the front of the neck.

The *incus* lies behind the malleus, and is often likened to a molar tooth. The simile may be heightened by likening it to a lower milk molar, on account of the great splay of its two fangs.

The body, which represents the crown of the tooth, has a deeply-notched articular surface which looks forwards to articulate with the facet on the back of the head of the malleus. The *long process* [crus longum] represents the anterior fang of the tooth, and runs down parallel with the handle of the malleus, but on a plane behind and internal to it (see Fig. 116, p. 257).

Between these two processes the chorda tympani nerve passes.

At its tip the long process of the incus turns inwards a little and ends in a small rounded knob, the *os orbiculare*, where it articulates with the stapes.

The *short process* [crus breve] is conical and more massive

than the long one; it passes horizontally backwards to the lower part of the aditus. It will be noticed that both the body and short process are in the attic.

Now disarticulate the incus and malleus in the longitudinal section (left side), and notice that the short process of the former is attached to the margin of the aditus by the *posterior ligament of the incus*, while a delicate capsule attaches it to the malleus.

In disarticulating the malleus its head will be found suspended from the tegmen tympani by the *superior ligament*, the posterior fibres of which run nearly horizontally backwards external to the body of the incus. An *anterior ligament* passes forwards from the root of the slender process into the Glaserian fissure, while the handle is attached to the tympanic membrane along the whole length of its outer border.

The insertion of the tensor-tympani tendon into the base of the handle has already been noticed.

The *stapes* will be found on the inner half of the longitudinal section, while in the transverse section both it and the incus often retain their relative positions. Its likeness to a stirrup laid upon its side is very striking, and it consists of a *head* [capitulum stapedis], which articulates with the os orbiculare of the incus; a *neck*, into which the tendon of the stapedius is inserted behind; an *anterior* and *posterior crus*, of which the latter is longer and more curved than the former; and a *footplate* [basis stapedis], which fits into the fenestra ovalis, and, like that opening, is kidney-shaped, the more convex border of the kidney being uppermost (see Fig. 117, p. 258).

It should be gently disengaged from the fenestra, to the margins of which it is attached by the *annular ligament*.

If these points have been carefully verified, there will be no difficulty in placing any of the three ossicles in their proper positions, or in telling to which side they belong.

The Internal Ear or Labyrinth

The student must be content to gain a general survey of the internal ear in the dissecting-room, but if this is carefully done it will make the more delicate histological study much easier to understand.

The internal ear consists of the cochlea, the vestibule, and the semicircular canals.

The Cochlea is seen to some extent in the section on the right side, which passes through the two auditory meatus; this generally cuts the inner wall of the tympanum at the promontory, and, as this promontory is caused by the first turn of the cochlea, it is possible that the section will only show one or two turns of the latter (see Fig. 115).

It must be realised that the cochlea is a spiral staircase, containing two and a half turns, twisted round a central pillar called the *modiolus.* The base of the modiolus is at the internal auditory meatus, but its apex points forwards and outwards, and a complete section through its long axis may be made by fixing the specimen in a vice and making a fret-saw cut from the bottom of the internal auditory meatus to the re-entering angle between the petrous and squamous parts of the temporal bone, or, if a third ear is available, by making the horizontal section advised on p. 253 (see Fig. 114).

The various turns of the spiral will now be seen, and it will be noticed that in each one a shelf of bone projects from the modiolus about half-way across the passage. This spiral shelf is called the *lamina spiralis*, and from its free end two membranes may just be made out running to the cochlear wall, and diverging as they go to enclose a canal which is triangular in section, and is known as the *scala media.*

This scala or staircase is particularly important, because it contains the *organ of Corti* [organon spirale], or essential organ of hearing. It is filled with a fluid known as endolymph.

Of the other two spaces in the coils of the cochlea the one which is nearer the apex of the modiolus is the *scala vestibuli,* while the one nearer the base is the *scala tympani;* these communicate at the apex of the cochlea, and are filled with a fluid known as perilymph.

Running along the interior of the modiolus to the lamina

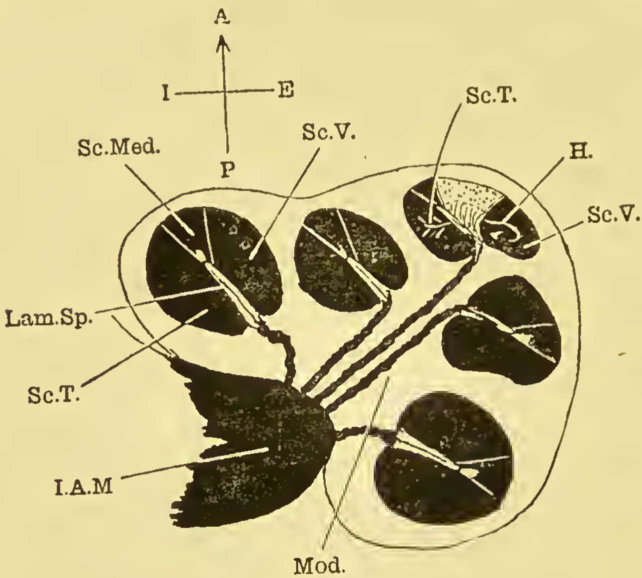


FIG. 120.—DIAGRAM OF THE RIGHT COCHLEA.

I.A.M. Internal Auditory Meatus. *Mod.* Modiolus. *Sc.T.* Scala Tympani. *Sc.Med.* Scala Media. *Sc.V.* Scala Vestibuli. *Lam.Sp.* Lamina Spiralis. *H.*, in the apical half-turn of the Cochlea, shows the continuity between the Scala Tympani and Vestibuli at the Helicotrema.

spiralis are delicate canals for branches of the auditory nerve to the organ of Corti. Their point of entry may be made out in a macerated temporal bone by looking down the internal auditory meatus and noticing a curved ridge, the *crista falciformis,* running across its bottom. Just below this a spiral tract of minute holes will be seen, the *tractus spiralis foraminulentus* [t.s. foraminosus].

The VESTIBULE is a small chamber behind the cochlea

it should be divided in the long axis of the petrous bone, as well as transversely. To divide it longitudinally the inner half of the left bone in which the longitudinal section of the tympanum was made should have another section taken parallel to the former one, and just on the medial side of the inner wall of the tympanum. This section lies about a quarter of an inch in front of the upper border of the petrous bone.

When the dissector realises that he wants to open up a very small space which lies just on the inner side of the fenestra ovalis, he will be able to adapt his saw-cut to the piece of bone with which he is dealing. The writer has obtained his best results with a fret-saw and vice.

If the two halves are looked at, the vestibule will be seen to be a conical space with its base directed outwards, and separated by a thin partition of bone from the posterior half of the tympanum, while its apex points backwards and inwards (see Fig. 121).

If the posterior half of the right temporal bone, in which the transverse section between the two meatus was made, is taken, another section may be cut with a fret-saw, passing through the fenestra ovalis and running backwards and outwards, which will divide the cavity into anterior and posterior halves.

In the base, which is best studied on the left side, the fenestra ovalis and fenestra rotunda are seen, while at its apex is the common opening of the superior and posterior semicircular canals.

The bony vestibule contains two membranous bags, which, however, cannot be satisfactorily demonstrated by macroscopic sections; the anterior of these is the *saccule*, the posterior the *utricle*.

The saccule lies in a little depression known as the *fovea hemispherica* [recessus sphæricus], on the anterior wall of the vestibule, and as near the bottom of the internal auditory meatus as the vestibule reaches.

Into this fovea opens the *area cribrosa media*, which con-

veys the branch of the eighth nerve to the saccule, and is seen below the hinder end of the crista falciformis in the bottom of the internal auditory meatus (see Fig. 123).

Nearer the top of the internal wall is the *fovea hemi-*

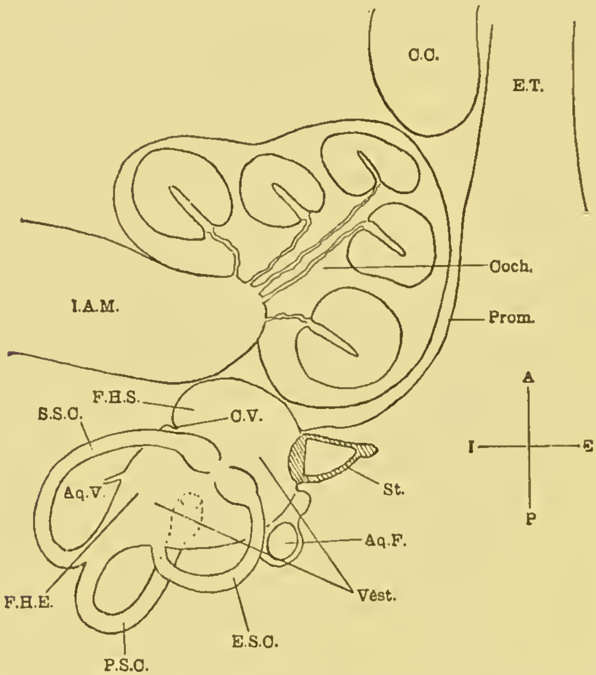


FIG. 121.—DIAGRAM OF THE RIGHT INTERNAL EAR, SEEN FROM ABOVE.

Coch. Cochlea. *Prom.* Promontory. *C.C.* Carotid Canal. *E.T.* Eustachian Tube. *I.A.M.* Internal Auditory Meatus. *Vest.* Vestibule. *F.H.S.* Fovea Hemispherica (lodging Saccule). *F.H.E.* Fovea Hemieliptica (lodging Utricle). *C.V.* Crista Vestibuli. *St.* Stapes fixed in Fenestra Ovalis. *Aq.F.* Aqueductus Fallopii (for Facial Nerve). *Aq.V.* Aqueductus Vestibuli. *S.S.C.*, *P.S.C.*, *E.S.C.* Superior, Posterior, and External Semicircular Canals.

eliptica [recessus clipticus], which lodges the utricle, and is perforated by a number of small foramina which, at the bottom of the internal auditory meatus, form the *area cribrosa superior.* This area lies just above the crista falciformis, and just behind the inner opening of the aqueduct of Fallo-

pius; it transmits the nerves to the utricle as well as to the ampullated extremities of the superior and external semicircular canals (see Fig. 123).

Between the fovea hemispherica and hemieliptica there is a little ridge known as the *crista vestibuli.*

All these structures on the antero-internal wall of the conical vestibule will be best seen in the front piece of the section on the left side, which has been made through the long axis of the vestibule.

From the highest point of the roof of the vestibule opens the ampullated extremity of the superior semicircular canal, and just behind it is the ampulla of the external semicircular canal. Both these openings are a little above and behind the fovea hemieliptica, where the utricle lies.

One more opening must be looked for in the fovea hemieliptica; it is a small but distinct foramen situated just in front of the common opening of the superior and posterior semicircular canals at the apex of the vestibule, and is the vestibular opening of the *aqueductus vestibuli,* which lodges the *saccus endolymphaticus,* and of which the cranial opening is seen on the posterior surface of the petrous bone below and external to the internal auditory meatus.

On the postero-external wall of the vestibule opens the non-ampullated extremity of the external semicircular canal, while a little lower down on the floor is the ampullated extremity of the posterior canal.

The Semicircular Canals [canales semicirculares] are three bony tunnels hollowed out in the very dense, ivory-like part of the temporal bone which lies between the elevation for the superior semicircular canal on the anterior surface of the petrous bone above and the jugular fossa below.

Each of these tunnels contains a very delicate membranous canal [ductus semicircularis], which is separated from the bone by the perilymph. It is possible, with great care, to chisel out these canals, as well as the vestibule and cochlea, and every anatomical museum has a specimen of

this kind, though few students have the time or skill to make one for themselves. A very good idea, however, of the positions of the eanals may be gained from sections, especially if they are compared with a museum specimen.

It will be notieed that the three canals lie in different planes, the external being horizontal, the superior nearly coronal, while the posterior is nearly sagittal, and that each of them has an *ampulla* or dilatation at one end. In this ampulla the membranous eanal enlarges so much that it fills the whole spaee, a thing which it does not nearly do elsewhere in the bony eanal, and it is here too that it reeeives its nerve supply.

The openings of the bony eanals into the vestibule have been noticed already, but, sinee their arrangement is diffieult to remember, they may be reviewed with advantage.

The first thing is to notiee elearly that the superior and posterior canals join together and have a eommon opening, ealled the *crus commune,* into the apex or postero-internal extremity of the vestibule, and that this eommon termination is the non-ampullated end of both tubes.

Then remember that the superior eanal is the coronal one, and that it is marked on the upper border of the petrous bone by an elevation for a brain suleus.

Strietly speaking, the canal has a rather different direction to this elevation, but, if this is remembered, the latter serves as a useful guide to the former (see Fig. 122). When its horizontal eourse is followed, one is not surprised to find that its ampullated extremity opens into the roof of the vestibule near the base (outer wall) of the latter.

The seetion made through the vestibule on the left side parallel with the upper border of the petrous bone euts the superior semieircular canal quite close to the anterior surface of that bone, and a piece of wire can be pushed through it quite easily.

The *posterior semicircular canal* after leaving the erus commune curves baekwards and downwards in the compaet

bone behind the vestibule, and then passes forwards and a little upwards to open into the floor of the vestibule by its ampullated extremity. It has not been cut in any of the foregoing sections, but if a horizontal section is made backwards from the posterior part of the vestibule on the right side, it will be divided and a wire may be pushed into both its ends.

The *external semicircular canal* is the independent and

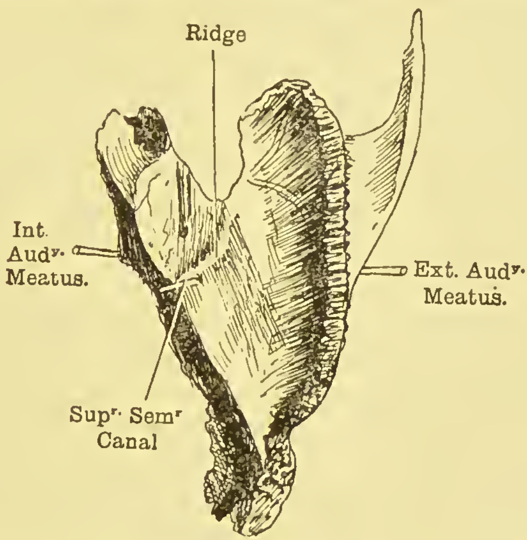


FIG. 122.—TEMPORAL BONE FROM ABOVE TO SHOW THE RELATIONSHIP OF THE OPENED-UP SUPERIOR SEMICIRCULAR CANAL TO THE RIDGE, WHICH IS USUALLY CREDITED WITH BEING RAISED BY THE CANAL.

horizontal one. Its ampulla opens quite close to that of the superior canal in the upper part of the vestibule just above and behind the fovea hemieliptica where the utricle lies.

This fact may be fixed in the mind if it is remembered that the auditory nerve consists of vestibular and cochlear divisions, and that the former supplies the utricle and the ampullæ of the superior and external semicircular canals. To find these three structures close together, therefore, is only what might reasonably be expected.

The external canal is cut in the section on the left side,

passing parallel to the upper border of the petrous bone through the vestibule, and a piece of wire pushed through the inner side of the cut canal will appear in the vestibule on its posterior surface.

The INTERNAL AUDITORY MEATUS and AQUEDUCT OF FALLOPIUS [canalis facialis] may be examined in the same piece of bone in which the inner part of the external semicircular canal has been investigated, but a dry left temporal bone must be at hand for comparison.

With a fret-saw and chisel remove the roof of the meatus and identify the facial nerve, which is the highest structure passing through it. This may be followed into the aqueduct of Fallopius, and if the other side of the same section is looked at, the aqueduct will be seen lying just above and behind the cochlea.

Place this section in a vice and chisel away the roof of the aqueduct very carefully until the sudden bend and slight swelling of the facial nerve, known as the *geniculate ganglion* [g. geniculi], comes into view. After this the nerve and its aqueduct pass backwards and downwards, until they are seen again in the inner wall of the tympanum.

When once the geniculate ganglion is opened up it is easy to expose the *great superficial petrosal nerve* which runs forwards and inwards from it to the hiatus Fallopii [hiatus canalis facialis] on the anterior surface of the petrous bone.

Below the facial nerve and coming off from it near the bottom of the internal auditory meatus, the *pars intermedia* should be looked for.

Below this is the vestibular branch of the auditory nerve, which, when it reaches the *lamina cribrosa,* as the perforated plate at the bottom of the internal auditory meatus is called, goes through the area cribrosa superior, above the crista falciformis, to reach, as has just been noticed, the utricle and the ampullæ of the superior and external semicircular canals.

Most of the openings at the bottom of the internal auditory meatus have been noticed already, but, as the

region is a difficult one and the relations of the various nerves are sometimes of clinical importance, no excuse is necessary for mentioning them again from another point of view.

1. The *opening of the aqueductus Fallopii* is the highest and transmits the facial nerve.

2. The *area cribrosa superior* comes next, and transmits the branch of the auditory nerve to the utricle, superior, and external semicircular canals.

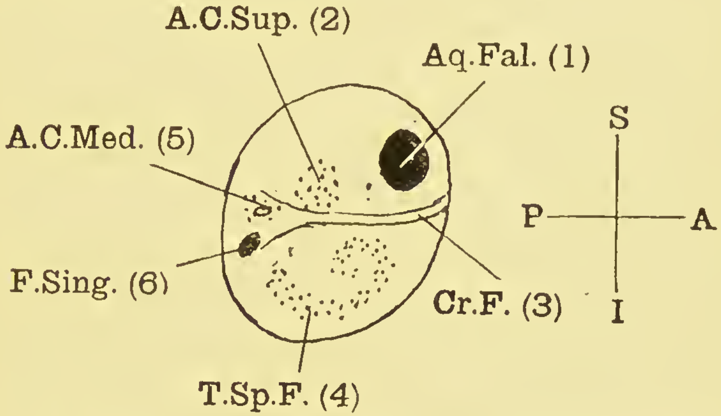


Fig. 123.—The Bottom of the Internal Auditory Meatus of the Left Side.

Aq.Fal.—Aqueductus Fallopii. *A.C.Sup.* Area Cribrosa Superior. *Cr.F.* Crista Falciformis. *Tr.Sp.F.* Tractus Spiralis. *A.C.Med.* Area Cribrosa Media. *F.Sing.* Foramen Singulare.

(The numbers in brackets refer to the list in the letterpress.)

3. The *crista falciformis* runs across and separates these from the rest.

4. The *tractus spiralis* lies just below the crista, and the nerves to the cochlea go through it.

5. The *area cribrosa media* lies behind the last and transmits the twigs to the saccule.

6. The *foramen singulare* is the lowest and most posterior of all the openings in the lamina cribrosa, and through it passes the nerve to the posterior semicircular canal.

The *auditory artery* is not very often injected; its branches pass in with the different nerves to all parts of the internal ear.

Now measure the depth of the internal auditory meatus, and notice that it is about a quarter of an inch.

Review of the Labyrinth or Internal Ear

Hitherto it has been the practice in this book to mention only those things which the student can see for himself in the dissecting-room, but in the case of the internal ear it seems advisable to link up those things which have been seen with those of which only glimpses have been obtained, and so, while the main landmarks are fresh in the memory, try to get a bird's-eye view of this intricate part.

It must be clearly understood that the membranous labyrinth, of which so little has been seen, is the part of physiological importance, and that this labyrinth lies in, though it seldom fits, the bony spaces which have been examined in detail.

Between the membranous and bony labyrinth lies the perilymph, while the membranous labyrinth itself is filled with endolymph.

The anterior part of the membranous labyrinth is coiled up in the cochlea as the scala media, while the scala vestibuli and scala tympani contain perilymph.

The bony vestibule contains two membranous bags, the saccule in front and the utricle behind, while the saccule is connected with the scala media in front by a narrow membranous tube called the *canalis reuniens*.

The saccule is connected with the utricle by a tube, which is Y-shaped, and known as the *ductus endolymphaticus*, the stalk of the Y projecting backward into the aqueductus vestibuli on the posterior surface of the petrous bone, its blind end lying in contact with the dura mater.

From the utricle open backward the three membranous

semicircular canals, which do not nearly fill the bony canals, except at their ampullated ends.

The bony vestibule has perilymph between its walls and those of the utricle and saccule, and this is continuous with the perilymph in the scala vestibuli of the cochlea.

At the apex of the cochlea is a place known as the *helicotrema*, at which the scala vestibuli becomes continuous with the scala tympani, but when the base of the cochlea is reached once more, the scala tympani ends blindly, its blind end being separated from the tympanum by the fenestra rotunda, across which is stretched the secondary membrane of the tympanum.

The different divisions of the auditory nerve end, as has been seen, in various parts of the membranous labyrinth.

If the foregoing arrangements are clearly understood, the grosser points in the mechanism of hearing will be easily grasped.

A sound wave strikes the tympanic membrane, presses it in, and so is communicated to the handle of the malleus. The malleus, however, is a lever, the fulcrum of which is the anterior ligament and the posterior fibres of the superior ligament, so that, as the handle moves in, the head moves out. The incus is also a lever, the fulcrum of which is at the short process, and as the head moves outwards with the head of the malleus, the long process moves in. This, of course, pushes the stapes farther into the fenestra ovalis, and increases the pressure in the perilymph of the vestibule. The increased tension passes up the scala vestibuli and then down the scala tympani, at the bottom of which it can bulge out the secondary membrane of the tympanum stretched across the fenestra rotunda; but in doing this an extra pressure is transmitted to the wall of the scala media, and so through its endolymph to the organ of Corti.

THE BRAIN

It is most important that every student should take a part in the dissection of at least two brains. As a rule, there is no difficulty in procuring a sufficient supply for this, but, if the brain in the head and neck dissected is the only one available, by far the best plan is for four dissectors to arrange to work together and to study the two brains in their allotted parts one after the other. In this way structures which are necessarily destroyed in exposing portions of one brain may be seen in the other.

It will be assumed that two dissectors have kept the brain which they removed in two portions during the dissection of the intra-cranial region, and have been able to procure another with the arachnoid membrane and blood vessels intact.

The second brain will probably be uninjected, but there is no difficulty in injecting it with coloured plaster of Paris, or better still melted gelatine mixed with some pigment.

This should be done by putting a glass nozzle fitted with a little india-rubber tubing into the internal carotid artery of one side and another one into the vertebral artery of the opposite side. The vertebral and internal carotid arteries into which no nozzle is put must of course be tied.

Then with an ordinary glass syringe inject the internal carotid first, and if any colour runs out of the nozzle in the vertebral the tubing may be compressed there. The pressure on the syringe should be slow, gentle and even.

When the internal carotid has taken as much as it will safely hold, the tubing attached to its nozzle should be tied or plugged, and the vertebral injected in the same way. It

is desirable to do this before the brain is placed in any hardening re-agent.

Now take the brain belonging to the dissector's part, and clear away the membranes and arteries completely from the outer side of one hemisphere in order to study the topography of its surface.

The reason for giving this advice is that if the arteries and membranes are examined first they will have to be studied in relation to parts of the brain of which the student at present knows nothing.

The Outer Surface of the Cerebrum

Before beginning the study of the surface of the brain the dissector should clearly understand that the fissures and convolutions are never exactly alike in any two brains, nor are the two sides of any single brain quite identical.

The following directions, therefore, are intended for an average brain, and in all cases of difficulty the help of a demonstrator should be sought.

First identify the three main fissures, putting a little coloured wool into each as it is found.

The Fissure of Sylvius [F. cerebri lateralis] runs backwards and upwards, and separates the tongue-like Temporal Lobe below from the rest of the outer surface of the cerebrum. At its posterior end it turns rather sharply upwards. The anterior part of it is very wide and deep, and is known as the stem or *Vallecula Sylvii* [fossa cerebri lateralis].

About an inch from the tip of the temporal lobe is the Sylvian Point, from which a short *anterior limb* of the fissure [ramus anterior horizontalis] passes horizontally forwards, another short *ascending limb* [ramus anterior ascendens] passes nearly vertically upwards, and the third or *posterior limb* [ramus posterior], already described, passes backwards.

This Sylvian point lies against the pterion on the surface

of the skull (see p. 80), the anterior limb of the fissure corresponding to the spheno-parietal suture.

Between these different parts of the Sylvian fissure are

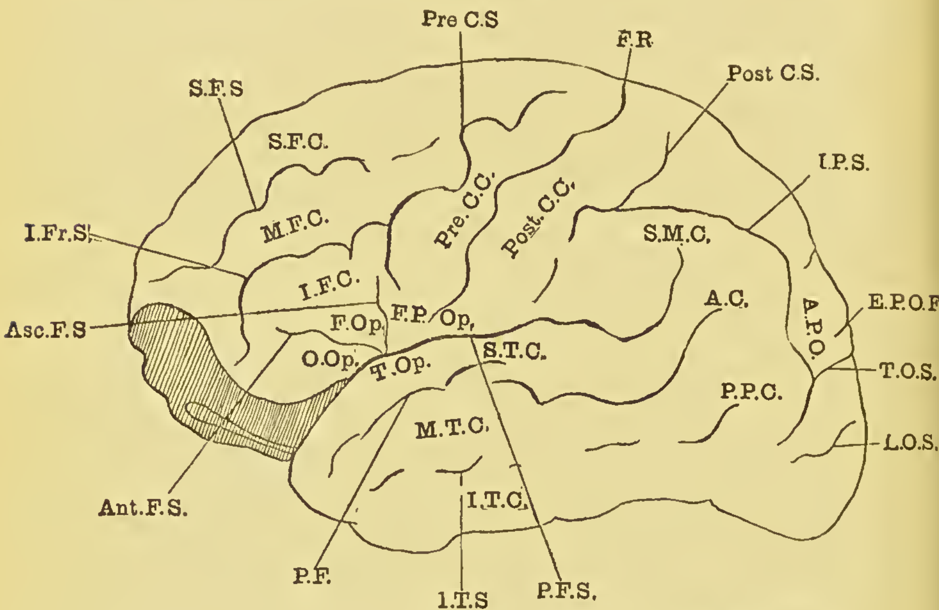


Fig. 124.—Lateral Surface of Cerebral Hemisphere.

Ant.F.S. Anterior Limb of Sylvian Fissure. *Asc.F.S.* Ascending Limb of Sylvian Fissure. *P.F.S.* Posterior Limb of Sylvian Fissure. *O.Op.* Orbital Operculum. *F.Op.* Frontal Operculum. *F.P.Op.* Fronto-parietal Operculum. *T.Op.* Temporal Operculum. *S.F.S.* Superior Frontal Sulcus. *I.Fr.S.* Inferior Frontal Sulcus. *S.F.C.* Superior Frontal Gyrus. *M.F.C.* Middle Frontal Gyrus. *I.F.C.* Inferior Frontal Gyrus. *Pre.C.S.* Pre-central Sulcus. *Pre.C.G.* Pre-central Gyrus. *F.R.* Fissure of Rolando. *Post.C.G.* Post-central Gyrus. *Post.C.S.* Post-central Sulcus. *I.P.S.* Intra-parietal Sulcus. *S.M.G.* Supra-marginal Gyrus. *A.G.* Angular Gyrus. *E.P.O.F.* External Parieto-occipito Fissure. *T.O.S.* Transverse Occipital Sulcus. *L.O.S.* Lateral Occipital Sulcus. *S.T.G.* Superior Temporal Gyrus. *M.T.G.* Middle Temporal Gyrus. *I.T.G.* Inferior Temporal Gyrus. *P.F.* Parallel Fissure. *I.T.S.* Inferior Temporal Sulcus. *P.P.G.* Post-parietal Gyrus.

included four more or less triangular tongues of brain which are known as opercula because they act as lids to the underlying island of Reil. Of these the *orbital operculum* lies between the stem and anterior horizontal limb of the fissure,

the *frontal operculum,* between the anterior and ascending limbs, the *fronto-parietal operculum,* between the ascending and posterior horizontal limbs, while the *temporal operculum* is formed by the temporal lobe (see Fig. 124).

The CENTRAL FISSURE or FISSURE OF ROLANDO [sulcus centralis] is of great clinical and physiological importance, because the motor centres are grouped in front of it. It starts, as far as the outer convex surface of the brain is concerned, at the very top about mid-way between the anterior (frontal) and posterior (occipital) poles of the brain, and runs downwards and forwards at an angle of about 72°, until it nearly reaches the posterior limb of the fissure of Sylvius, an inch behind the Sylvian point. It ends, therefore, in the back part of the fronto-parietal operculum. It has several curves, two of which (the *superior* and *inferior genua*) are specially marked.

The *superior genu* is convex backwards, and has the arm centre just in front of it, while the *inferior genu* is convex forwards. If the lips of the fissure are pulled apart, several deep interlocking gyri [g. profundi] are seen at the bottom of it.

The next fissure to identify is the EXTERNAL PARIETO-OCCIPITAL, which corresponds very closely to the lambda on the surface of the skull (see p. 80). It only runs down for about half an inch from the upper border of the brain. A useful method of finding it is to continue the general direction of the posterior horizontal limb of the Sylvian fissure backwards with a piece of string or ruler, neglecting the upturned hinder end of the limb; but a still better way, when the medial surface of the brain can be seen, is to look for its continuity with the well-marked internal parieto-occipital fissure (see Fig. 125).

When these fissures have been identified the lobes on the outer surface of the brain should be determined.

The FRONTAL LOBE is that part which lies above the level of the Sylvian fissure and in front of the central fissure (Fig. 125).

The Occipital Lobe is arbitrarily marked off by drawing a line downwards and a little forwards from the external parieto-occipital fissure to the lower margin of the brain. In children's brains and in those of adults hardened by formation *in situ* there is sometimes a little indentation, the *pre-occipital notch,* in this position, but it is so inconstant as to

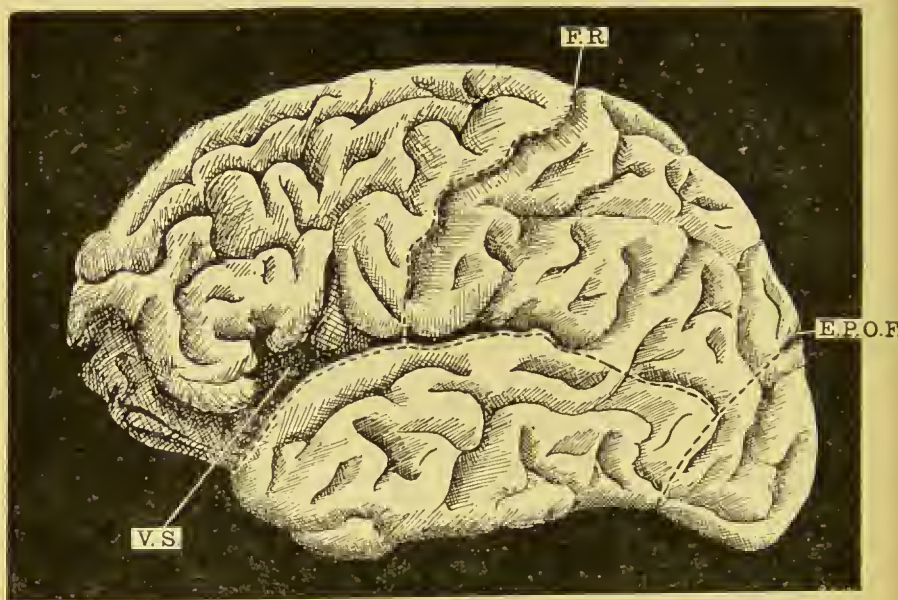


Fig. 125.—The Lobes of the Cerebrum.

F.R. Fissure of Rolando, in front of which is the Frontal Lobe. *E.P.O.F.* External Parieto-occipital Fissure, between which and the Fissure of Rolando is the Parietal Lobe, and behind which is the Occipital Lobe. *V.S.* Vallecula Sylvii, in which is the Central Lobe, and below which is the Temporal Lobe.

be of little practical value. When it is present it is used as the mark for the lower limit of the boundary of the occipital lobe.

The Temporal Lobe is bounded above by the stem of the Sylvian fissure and its posterior horizontal limb. Where this turns up the line of the posterior limb is continued back until it cuts the arbitrary line marking off the front of the occipital lobe. Posteriorly this arbitrary line separates it

from the occipital lobe, while below is the lower margin of the brain. The tip of this tongue-shaped lobe which projects forwards is known as the *Temporal pole.*

The Parietal Lobe occupies the rest of the external surface of the cerebrum, and is bounded in front by the central fissure, behind by the artificial boundary of the occipital lobe and the external parieto-occipital fissure, above by the upper border of the brain, and below by

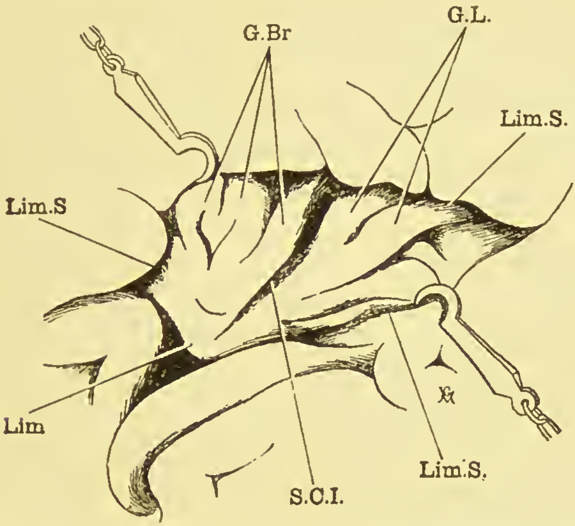


Fig. 126.—Insula or Island of Reil of the Left Side with the Opercula hooked aside.

G.Br. Gyri Breves. *G.L.* Gyri Longi. *S.C.I.* Sulcus Centralis Insulæ. *Lim.S.* Limiting Sulcus. *Lim.* Limen.

the posterior limb of the Sylvian fissure and its backward prolongation.

The Island of Reil, Insula or Central Lobe should be looked for by drawing apart the edges of the Sylvian fissure; this does not give an altogether complete view of it, but later on the various opercula may be cut away, after which it will be fully exposed.

It is triangular with the apex below, and is bounded on every side except at the apex by the *limiting sulcus* [s.

circularis], of which, of course, there are three parts, anterior, posterior, and superior.

The surface of the island has convolutions radiating fanwise from its apex; the anterior four or five are short (*gyri breves*), while the posterior one or two are longer (*gyri longi*), and these two sets are separated from one another by a *sulcus centralis insulæ*, which has the same direction as that of the Sylvian fissure (see Fig. 126).

On the SURFACE OF THE FRONTAL LOBE look for the *precentral sulcus* lying about half an inch in front of and parallel to the central fissure of Rolando. Between the two lies the *precentral gyrus* [g. centralis anterior], which, as has been already indicated, is a part of the brain of extreme practical interest on account of the important centres contained in it.

The rest of the surface of the frontal lobe, in front of the precentral sulcus, is divided into three horizontal convolutions, the *upper, middle,* and *lower frontal gyri,* the two former being very often subdivided by secondary horizontal sulci.

The posterior part of the inferior frontal gyrus includes the frontal and part of the fronto-parietal opercula, and on the left side this part contains a part at least of the motor speech centre, and is often known as BROCA'S CONVOLUTION.

On the surface of the parietal lobe the POST-CENTRAL GYRUS [g. centralis posterior] runs up parallel to and just behind the central fissure of Rolando, and its lower end is continuous with the posterior part of the fronto-parietal operculum. It is bounded posteriorly by the *post-central sulcus,* which sometimes has a break about its middle.

Running horizontally backwards from near the middle of the post-central sulcus is the *Intra-parietal sulcus* [s. interparietalis], which divides the rest of the parietal lobe into a *supra-parietal* and an *infra-parietal lobule.* When the post-central sulcus is in two parts, this intra-parietal sulcus joins the lower of the two. Posteriorly it very often runs into another sulcus situated in the occipital lobe and called the

transverse occipital, and when this is the case the post-central, intra-parietal, and transverse occipital sulci make an H with a very elongated and somewhat curved cross-bar.

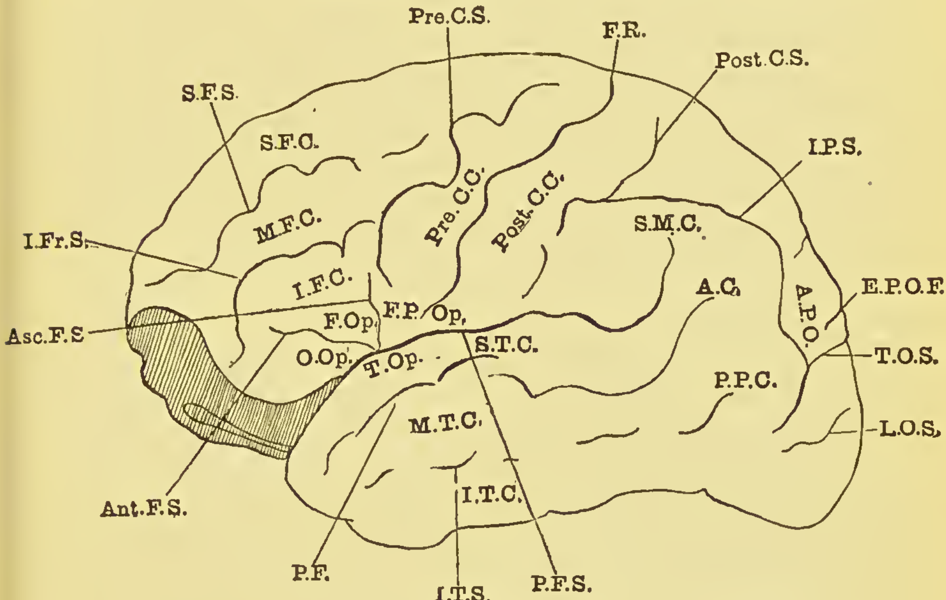


Fig. 127.—Lateral Surface of Cerebral Hemisphere.

Ant.F.S. Anterior Limb of Sylvian Fissure. *Asc.F.S.* Ascending Limb of Sylvian Fissure. *P.F.S.* Posterior Limb of Sylvian Fissure. *O.Op.* Orbital Operculum. *F.Op.* Frontal Operculum. *F.P.Op.* Fronto-parietal Operculum. *T.Op.* Temporal Operculum. *S.F.S.* Superior Frontal Sulcus. *I.Fr.S.* Inferior Frontal Sulcus. *S.F.C.* Superior Frontal Gyrus. *M.F.C.* Middle Frontal Gyrus. *I.F.C.* Inferior Frontal Gyrus. *Pre.C.S.* Pre-central Sulcus. *Pre.C.G.* Pre-central Gyrus. *F.R.* Fissure of Rolando. *Post.C.G.* Post-central Gyrus. *Post.C.S.* Post-central Sulcus. *I.P.S.* Intra-parietal Sulcus. *S.M.G.* Supra-marginal Gyrus. *A.G.* Angular Gyrus. *E.P.O.F.* External Parieto-occipital Fissure. *T.O.S.* Transverse Occipital Sulcus. *L.O.S.* Lateral Occipital Sulcus. *S.T.G.* Superior Temporal Gyrus. *M.T.G.* Middle Temporal Gyrus. *I.T.G.* Inferior Temporal Gyrus. *P.F.* Parallel Fissure. *I.T.S.* Inferior Temporal Sulcus. *P.P.G.* Post-parietal Gyrus.

In the infra-parietal lobule the upturned hinder end of the posterior limb of the fissure of Sylvius ends, and above its termination is an arched convolution called the *supra-marginal gyrus*. This always lies deep to the parietal

eminence of the skull and corresponds to the point of greatest convexity of a well-hardened brain. Behind and a little above the supra-marginal is the *angular gyrus*, the shape of which is usually described by its name. This arches over the hinder end of the upper temporal sulcus to be presently described, while at the very back of the infra-parietal lobule another convolution arches over the hind end of the lower temporal sulcus and is known as the *post-parietal gyrus*. The identification of these two last gyri is in some brains extremely difficult, and the greater experience of a demonstrator is often needed. The *surface of the occipital lobe* is very variable, but a convolution can usually be seen passing below the short external parieto-occipital fissure connecting the supra-parietal lobule with the upper part of the occipital lobe; it is concave upwards and is called the *arcus parieto-occipitalis*. It is bounded below by the posterior part of the intra-parietal sulcus, and more posteriorly by the transverse occipital sulcus, which the intra-parietal so often joins. This *transverse occipital sulcus* begins at the upper border of the cerebrum, a little behind the external parieto-occipital fissure, and generally runs forwards at first and then downwards and forwards. Below it there is often another fairly well-defined sulcus known as the *lateral occipital*, so that in a typical brain there are, including the arcus parieto-occipitalis, three occipital gyri or groups of gyri to be made out. A small region close to the occipital pole is of special importance, since the visual area encroaches on the convex outer surface here.

The surface of the temporal lobe has two sulci, superior and inferior, of which the superior is also called the *parallel sulcus*, from its relation to the Sylvian fissure, while the inferior often has breaks in its continuity. These two sulci separate three horizontal *temporal gyri*, superior, middle, and inferior. The Superior Temporal Gyrus is of importance, because its middle third contains the auditory centre.

THE BASE OF THE BRAIN

In removing the brain from the head the dissectors divided the crura cerebri, so that all the parts above the tentorium cerebelli are in the larger specimen, while those below are in the smaller.

The greatest difficulty in cleaning the brain will be found in the base where the cranial nerves are. These should be cleaned with scissors or a very sharp knife, taking great care not to grasp them with the forceps, since they tear away from the brain so very easily.

Starting from in front the inferior surface of the frontal lobe is seen on each side, and it will be noticed that it is concave from side to side to adapt it to the convex orbital roof. There is an *intra-orbital sulcus* which is very inconstant, but is most often H-shaped, and then divides the surface into *external, internal, anterior, and posterior orbital gyri*. Of these the external is continuous with the inferior frontal convolution on the outer surface of the brain, while the internal is bounded medially by a straight sulcus (*sulcus rectus* or *olfactory sulcus*), which lodges the olfactory tract and bulb. Internal to this, between it and the longitudinal fissure, is the *gyrus rectus*, the posterior part of which belongs functionally to the olfactory region of the brain and is known as *Broca's area* [area parolfactoria]. Note that this has nothing to do with Broca's convolution, the motor speech centre (see p. 284).

The Olfactory Bulb lies *under* (in the anatomical position) the sulcus rectus, and is an oval mass of grey matter, from which the numerous *olfactory nerves* pass through the cribriform plate of the ethmoid. These are so delicate that nothing is likely to be seen of them.

The Olfactory Tract is a narrow band, triangular in section, and about three-quarters of an inch long, which runs back from the bulb beneath the sulcus rectus and, widening

at its posterior end, divides into three roots, external, middle, and internal.

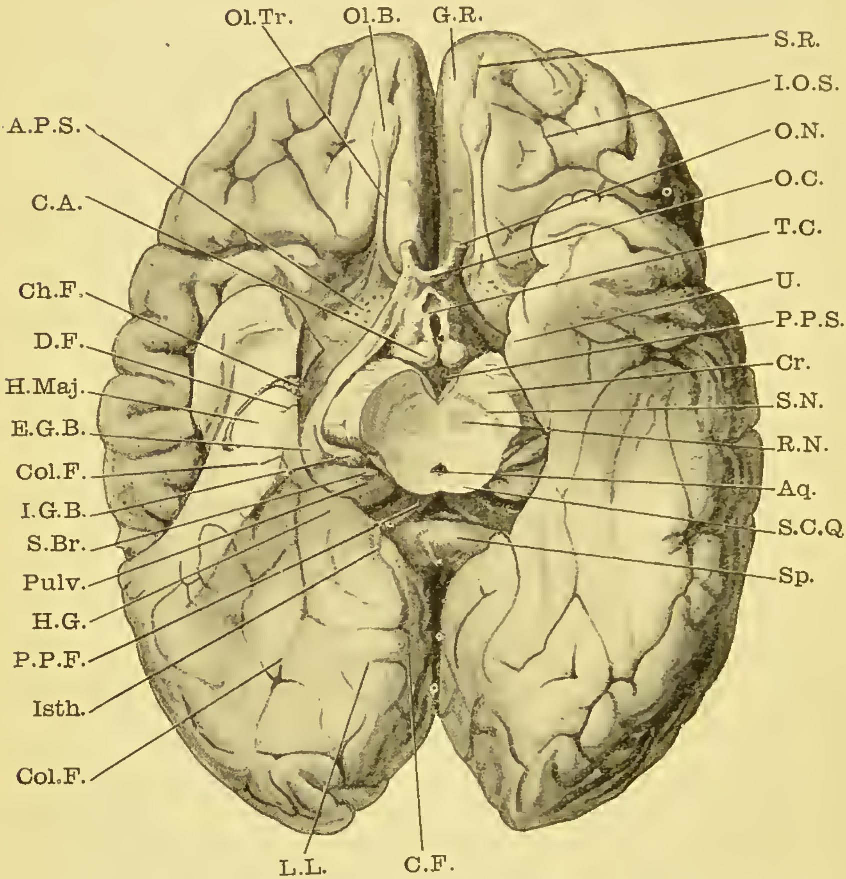


Fig. 128.—Dissection of the Base of the Cerebral Hemispheres.

G.R. Gyrus Rectus. *S.R.* Sulcus Rectus. *I.O.S.* Intraorbital Sulcus. *O.N.* Optic Nerve. *O.C.* Optic Commissure. *T.C.* Tuber Cinereum. *U.* Uncus. *P.P.S.* Posterior Perforated Space. *Cr.* Crusta. *S.N.* Substantia Nigra. *R.N.* Red Nucleus. *Aq.* Aqueduct of Sylvius. *S.C.Q.* Superior Corpora Quadrigemina. *Sp.* Splenium. *C.F.* Calcarine Fissure. *L.L.* Lingual Lobe. *Col.F.* Collateral Fissure. *Isth.* Isthmus. *P.P.F.* Posterior Pillars of Fornix. *H.G.* Hippocampal Gyrus. *Pulv.* Pulvinar. *S.Br.* Superior Brachium. *I.G.B.* Internal Geniculate Body. *E.G.B.* External Geniculate Body. *H.Maj.* Hippocampus Major. *D.F.* Dentate Fissure. *Ch.F.* Choroidal Fissure with Choroid Plexus reflected into it. *C.A.* Corpus Albicans. *A.P.S.* Anterior Perforated Space. *Ol.Tr.* Olfactory Tract. *Ol.B.* Olfactory Bulb.

The external root [stria olfactoria lateralis] runs across the apex of the island of Reil towards the uncus.

The internal root [s.o. medialis] turns inwards on to the medial surface of the brain, where it becomes continuous with the callosal convolution.

The middle root [s.o. intermedia], which is only faintly marked, passes backward to the region of the *anterior perforated space* [substantia perforata anterior], which is the floor of the triangle enclosed between the outer and inner roots.

The anterior perforated space is continuous externally with the apex of the island of Reil (*limen insulæ*), and its perforations transmit numerous arteries and veins, which will be noticed later, to the interior of the brain.

The OPTIC COMMISSURE or CHIASMA lies just behind the level of the anterior perforated spaces of the two sides. Running forwards from it on each side are the two cut optic nerves, while running back on each side are the two *optic tracts* which disappear under cover of the uncus, a structure better studied on the medial surface of the cerebrum.

Draw back the optic commissure gently and notice a very thin layer of non-nervous tissue called the *lamina cinerea* [l. terminalis]; it is so delicate that it is easily torn through, and then the cavity of the third ventricle is exposed.

Just behind the optic commissure is the TUBER CINEREUM, an ovoid, dark-coloured swelling, with its long axis transverse. From its inverted summit the INFUNDIBULUM or stalk of the pituitary body descends.

The PITUITARY BODY [hypophysis cerebri], removed from its fossa and preserved with the rest of the brain, should now be examined.

The large anterior part is glandular and is disproportionately large in giants. It is originally derived from the nasal mucous membrane (stomodæum), and therefore has, strictly speaking, nothing to do with the brain.

The small posterior part is continuous with the infundibulum, and is received into a notch in the posterior surface of the anterior part; it is a down growth of the brain.

Behind the tuber cinereum are a pair of small white hemispheres called the CORPORA ALBICANTIA [c. mammillaria], and behind these again the *posterior perforated space* is seen lying between the crura cerebri.

The CRURA CEREBRI [pedunculi cerebri] were cut in removing the cerebrum, but may be easily reconstructed by replacing the cerebellum. They will then be seen to diverge from the upper part of the pons Varolii, which unites the two halves of the cerebellum, and to disappear under cover of the uncus (see Fig. 130).

Now follow the optic tract backwards, and in order to do so draw aside the temporal lobe.

As it runs back round the outer side of the crus the tract broadens and divides into an outer and an inner root. The outer root [radix lateralis] again divides, so that there are now three bands—outer, middle, and inner.

Of these the outer ends in a swelling, the *external geniculate body* [corpus geniculatum laterale], while the inner band passes into the *internal geniculate body* [c.g. mediale], which is a more sharply-marked swelling than the outer, and is situated rather farther back on the dorsal side of the crus.

Behind and above these two swellings (when the brain is in its natural position) is the overhanging hind end of the optic thalamus, known as the *pulvinar*, and between this and the internal geniculate body the middle of the three divisions of the optic tract passes to the upper quadrigeminal body (see Fig. 129).

This third division of the tract is called the *superior brachium*.

The CORPORA QUADRIGEMINA are four rounded bodies which lie dorsal to, *i.e.* above, the crura cerebri, and below and internal to the pulvinar. The section made through the

crura in removing the brain usually passes through the upper pair of these (Fig. 129, S.C.Q.).

It will be noticed that the superior corpora quadrigemina [colliculi superiores] are larger than the inferior [cc. inferiores], and have the pineal body just above them, resting in the medial groove which separates the superior colliculus of one side from that of the other.

Each of the four colliculi has a brachium or ridge running outwards from it.

The external geniculate body, the upper quadrigeminal body, and the pulvinar are known collectively as the *lower visual centres.*

A bundle of fibres, the *inferior brachium*, connects the internal geniculate with the lower quadrigeminal body, but these structures form part of the apparatus of hearing.

Just external to the outer geniculate body is a narrow band called the *tænia semicircularis*, which will be met with again.

Now freshen the *section through the crura cerebri* by taking a thin slice off with a sharp knife, and notice that each consists of a ventral part, the *crusta*, which is quite distinct from its fellow of the opposite side, and contains the motor nerve paths; and a dorsal part, the *tegmentum*, united to its fellow across the middle line, and containing the sensory nerve paths.

The two parts of each crus are separated by a dark irregular band, the *substantia nigra*, while nearer the dorsal side a section of the *aqueduct of Sylvius* appears in the mid line looking like a capital T. Still more dorsally (*i.e.* posteriorly) either the superior or inferior pair of quadrigeminal bodies, probably the superior, will be cut through (see Fig. 129).

Behind these the *splenium*, or hind end of the corpus callosum, will be seen when the membranes have been removed.

If the section through the crura has passed through the upper quadrigeminal body, as it generally does, look out for

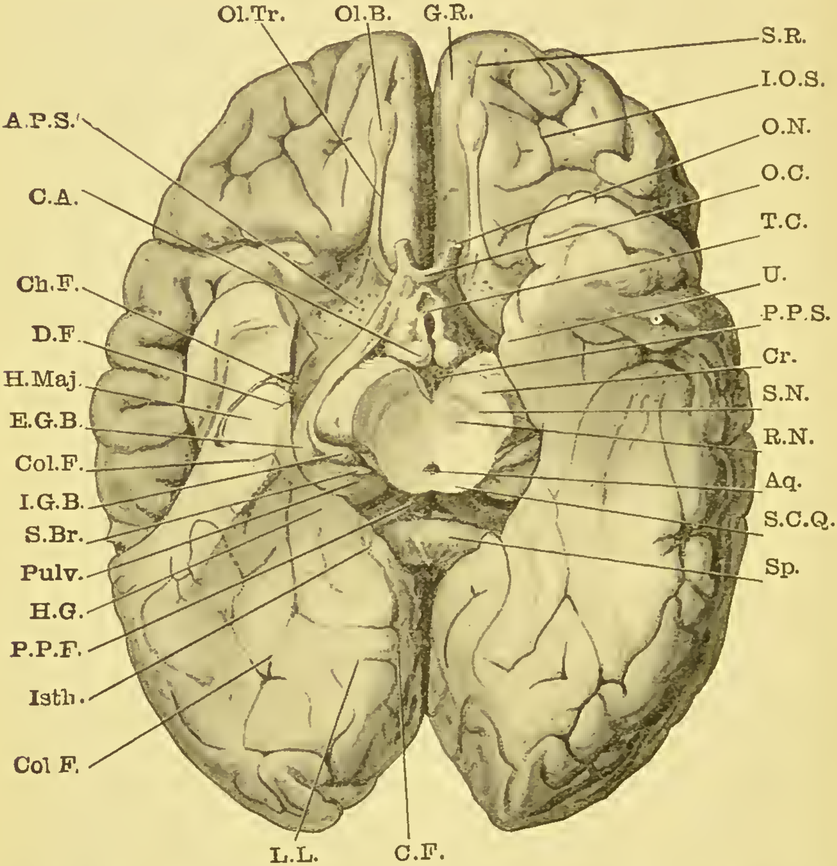


Fig. 129.—Dissection of the Base of the Cerebral Hemispheres.

G.R. Gyrus Rectus. *S.R.* Sulcus Rectus. *I.O.S.* Intraorbital Sulcus. *O.N.* Optic Nerve. *O.C.* Optic Commissure. *T.C.* Tuber Cinereum. *U.* Uncus. *P.P.S.* Posterior Perforated Space. *Cr.* Crusta. *S.N.* Substantia Nigra. *R.N.* Red Nucleus. *Aq.* Aqueduct of Sylvius. *S.C.Q.* Superior Corpora Quadrigemina. *Sp.* Splenium. *C.F.* Calcarine Fissure. *L.L.* Lingual Lobe. *Col.F.* Collateral Fissure. *Isth.* Isthmus. *P.P.F.* Posterior Pillars of Fornix. *H.G.* Hippocampal Gyrus. *Pulv.* Pulvinar. *S.Br.* Superior Brachium. *I.G.B.* Internal Geniculate Body. *E.G.B.* External Geniculate Body. *H.Maj.* Hippocampus Major. *D.F.* Dentate Fissure. *Ch.F.* Choroidal Fissure with Choroid Plexus reflected into it. *C.A.* Corpus Albicans. *A.P.S.* Anterior Perforated Space. *Ol.Tr.* Olfactory Tract. *Ol.B.* Olfactory Bulb.

a circular reddish patch on each side dorsal to the substantia nigra. This is the *red nucleus*, and it is quite possible that fibres of the third or oculo-motor nerve may be traced through it from their nucleus in the floor of the Sylvian aqueduct to the groove on the inner side of each crus.

When the temporal lobe is drawn aside, notice how the crus of that side gradually sinks into the substance of the cerebrum. Notice, too, how the optic tract, running backwards from the optic commissure, crosses superficial to (below) the crus.

In this way the two crura, the two optic tracts, and the optic commissure enclose a pentagonal area known as the INTERPEDUNCULAR SPACE, the contents of which from before back are the tuber cinereum with its infundibulum, the corpora albicantia, and the posterior perforated space.

On the inner side of each crus, between the crusta and the tegmentum, is the *oculo-motor groove* [sulcus n. oculomotorii], from which the *third cranial* or *oculo-motor nerve* takes its superficial origin (see Fig. 130).

Winding round the outer side of the crus is the delicate *trochlear* or *fourth cranial nerve*, but this is likely to be below the point of section, since it rises from the roof of the fourth ventricle.

If these nerves are not seen in the first brain they should be looked for very carefully in the second later on.

Behind the crura cerebri is the PONS VAROLII, a large commissure between the two halves of the cerebellum. The transverse direction of its superficial fibres is quite evident, and in the median line is a slight furrow for the basilar artery. The large *trigeminal* or *fifth cranial nerves* emerge from it about an inch from the mid line, and the small motor root should be distinguished from the large sensory, lying close to the inner side of the latter.

On each side the pons disappears into the substance of the cerebellum.

At its posterior border, quite close to the mid line, the

abducens or *sixth cranial nerve* has its superficial origin, while a little more laterally, in a triangle formed by the pons

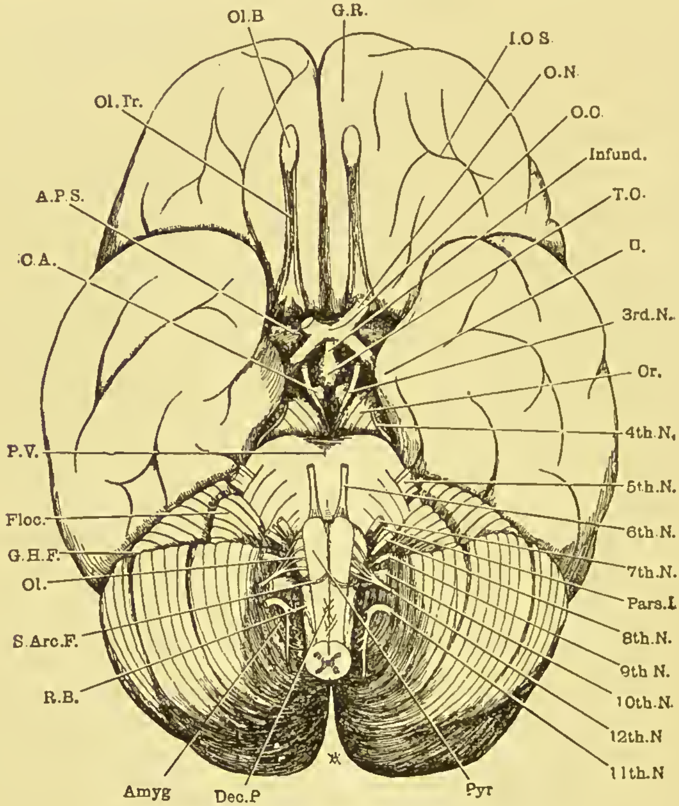


FIG. 130.—THE BASE OF THE BRAIN.

G.R. Gyrus Rectus. *Ol.B.* Olfactory Bulb. *Ol.Tr.* Olfactory Tract. *I.O.S.* Intraorbital Sulcus. *O.N.* Optic Nerve. *O.C.* Optic Commissure. *A.P.S.* Anterior Perforated Space. *Infund.* Infundibulum. *T.C.* Tuber Cinereum. *C.A.* Corpus Albicans. *U.* Uncus. 3*rd*, 4*th*, 5*th*, 6*th*, 7*th*, 8*th*, 9*th*, 10*th*, 11*th*, 12*th N.* Corresponding Cranial Nerves. *Cr.* Crusta. *P.V.* Pons Varolii. *Floc.* Flocculus. *Pyr.* Anterior Pyramid of Medulla. *Pars.I.* Pars Intermedia. *G.H.F.* Great Horizontal Fissure of Cerebellum. *Ol.* Olive. *S.Arc.F.* Superficial Arcuate Fibres. *R.B.* Restiform Body. *Amyg.* Amygdala. *Dec.P.* Decussation of Pyramids.

anteriorly, the medulla internally and the cerebellum posteriorly, appear the *facial* or *seventh*, and the *auditory* or *eighth* cranial nerves, the seventh being the more internal.

Between the two the *pars intermedia,* a delicate nerve bundle, should be looked for.

Behind and below the pons is the ventral surface of the Medulla Oblongata, a conical structure about an inch long, tapering as it descends to become continuous with the spinal cord.

In the mid line of the medulla is the *antero-median fissure,* on each side of which lie the *pyramids.* Open up the median fissure very carefully, and it will be seen that fibres from the greater part of the pyramids decussate in order to form the crossed pyramidal tract of the cord. This occurs in the lower part of the medulla, about the level of the foramen magnum.

On the outer side of each pyramid lies the oval *olive,* and, from the cleft between them, the fibres of the *hypoglossal* or *twelfth cranial nerve* emerge in a vertical line.

Behind the olive the *restiform body* runs up, and then turns outwards and backwards into the cerebellum, forming the *inferior cerebellar peduncle.*

Just below the olive, on each side, some curved fibres, with their concavity upwards, should be looked for; they come out of the anterior median fissure, and curve round the lower pole of the olive to join the restiform bodies. They are known as the *anterior superficial arcuate* fibres [fibræ arcuatæ externæ], and they vary very much in distinctness in different brains.

From the groove between the olive and restiform body of each side emerge the fibres of the *glosso-pharyngeal* or *ninth cranial nerve,* the *vagus* or *tenth,* and the *spinal accessory* or *eleventh* from above downwards.

On each side of the medulla and pons is the Inferior Surface of the Cerebellum, which may be conveniently studied now as far as it can be seen.

If the lateral parts of the pons Varolii are followed into the cerebellum, of which they form the middle peduncles, they will be seen to divide the organ into a superior and an

inferior part, and this division is continued back by the *great horizontal fissure* [sulcus horizontalis cerebelli]. If this is opened up with a seeker it will be found to be very deep, though, of course, the upper and lower parts of the cere-

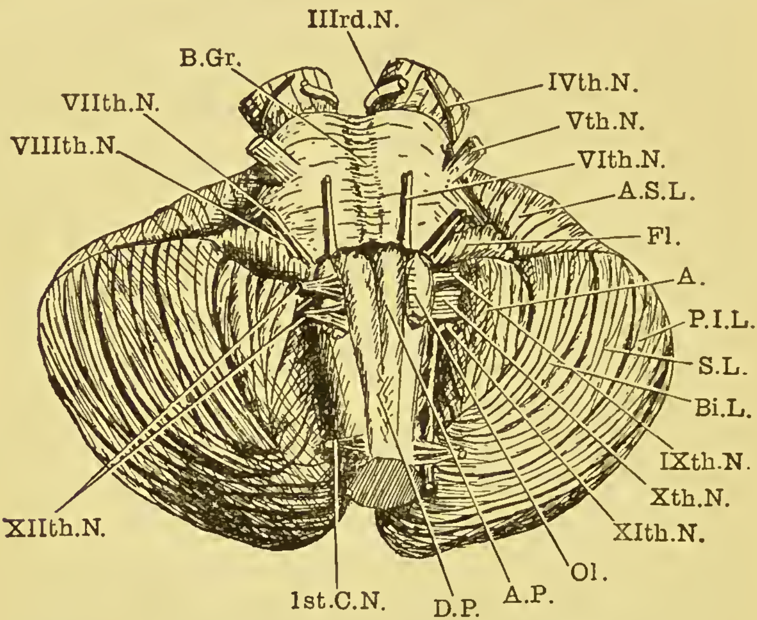


FIG. 131.—THE VENTRAL SURFACE OF THE CEREBELLUM, PONS AND MEDULLA.

IIIrd N., IVth N., Vth N., VIth N., VIIth N., VIIIth N., IXth N., Xth N., XIth N., XIIth N. The corresponding Cranial Nerves. *B.Gr.* Groove for Basilar Artery. *A.S.L.* Anterior Superior Lobe. *Fl.* Flocculus. *A.* Amygdala. *Bi.L.* Biventral Lobe. *S.L.* Slender Lobe. *P.I.L.* Posterior Inferior Lobe. *Ol.* Olive. *A.P.* Anterior Pyramid. *D.P.* Decussation of Pyramids. 1*st C.N.* First Cervical Nerve.

bellum are quite continuous when the bottom of the fissure is reached.

The only portion of the upper part of the cerebellum which is seen from this aspect in an undissected brain is a triangular piece on each side, appearing from under cover of the middle cerebellar peduncle (lateral part of the pons),

and prolonged round the margin of the cerebellum just above the great horizontal fissure. (A.S.L. Fig. 131.)

Ventral to (below) the middle cerebellar peduncle is the *flocculus*, a small triangular lobule, very sharply defined from the rest of the cerebellum and lying external to and behind the superficial origin of the seventh and eighth nerves.

Behind the flocculus is the *amygdala* or *tonsil*. This is largely concealed by the medulla at present, but when the latter is lifted up a little and the parts looked at from behind, the likeness to the tonsils in the throat is very striking.

The rest of the inferior surface of the cerebellum is divided into several lobules, which are of no great clinical or morphological importance. Their details, if needed, will be found in Fig. 131.

The Upper Surface of the Cerebellum.—Now turn the cerebellum over and look at it from above. It consists of a median worm-like elevation, running antero-posteriorly, with a lateral lobe on each side.

The elevation is known as the *superior vermis*, but its anterior part is hidden by the corpora quadrigemina, and, in order to see it, the best plan is to bisect the crura cerebri, pons, and medulla, keeping carefully to the mid line; then remove one-half of these by cutting through the superior, middle, and inferior cerebellar peduncles, where they are entering the cerebellum laterally. If this is carefully done, the piece removed can be easily replaced.

Look at the medial cut surface of the crura and identify the aqueduct of Sylvius, which should have been laid open in its whole length if the mid line has been carefully kept; the corpora quadrigemina lie dorsal to it (see Fig. 132).

When the lower limit of the corpora quadrigemina is reached, the aqueduct opens into the Fourth Ventricle, and the upper part of this is seen to be roofed over by an awning of white matter stretching from the lower edge of the corpora quadrigemina to the cerebellum, which it reaches between the anterior ends of the superior and inferior

vermes. This is the *superior medullary velum* or *valve of Vieussens,* and on its dorsal or upper surface are four or five delicate transverse folds of grey matter known as the *lingula,* from the tongue-like patch which they form. This is the most anterior part of the superior vermis, the surface of

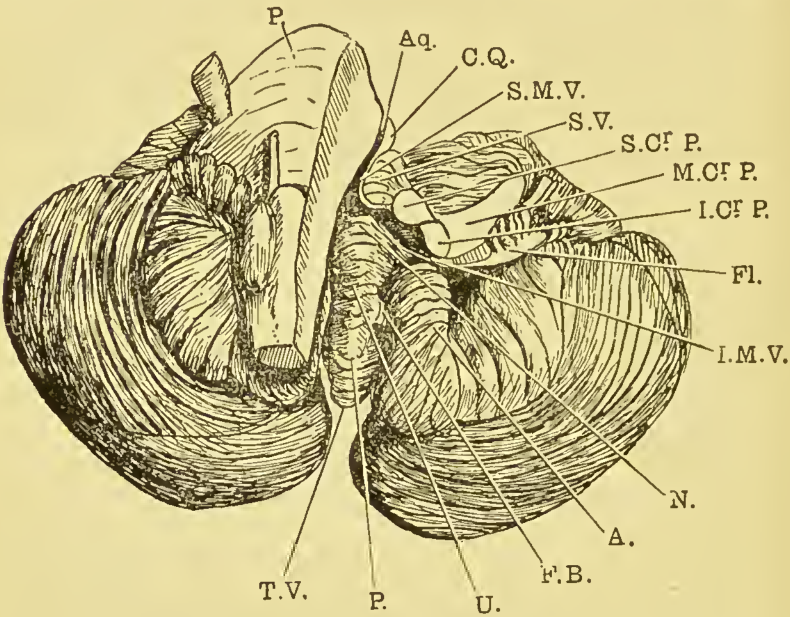


FIG. 132.—VENTRAL OR LOWER SURFACE OF PONS, MEDULLA, AND CEREBELLUM, FROM WHICH HALF THE PONS AND MEDULLA HAVE BEEN REMOVED.

P. Pons. *Aq.* Sylvian Aqueduct. *C.Q.* Corpora Quadrigemina. *S.M.V.* Superior Medullary Velum. *S.V.* Superior Vermis. *S.Cr.P.* Superior Cerebellar Peduncles. *M.Cr.P.* Middle Cerebellar Peduncles. *I.Cr.P.* Inferior Cerebellar Peduncles. *Fl.* Flocculus. *I.M.V.* Inferior Medullary Velum. *N.* Nodule. *A.* Amygdala. *F.B.* Furrowed Band. *U.* Uvula. *P.* Pyramid. *T.V.* Tuber Valvulæ.

which then runs almost vertically upwards, and later bends rather sharply backwards and downwards to its hinder end.

THE INFERIOR VERMIS AND ROOF OF THE FOURTH VENTRICLE.—The removal of half the pons and medulla allows the lower worm to be studied, and at the same time preserves on one side its relations to the fourth ventricle.

The specimen should be held in such a way that the front of the half medulla and pons is facing the observer and is vertical.

Look at the half from which the medulla has been removed and identify the cut cerebellar peduncles, the flocculus, and the vertical part of the upper worm. Notice, too, the superior medullary velum and trace it laterally to the superior cerebellar peduncle; this may easily be done on the intact side.

It will now be quite evident (1) that this velum forms the roof of the upper half of the diamond-shaped fourth ventricle; (2) that it is triangular in shape; (3) that its sides are attached to the superior cerebellar peduncles; (4) that its base is attached to the cerebellum between the front ends of the upper and lower worms; while (5) its apex just reaches the inferior quadrigeminal bodies between the converging superior cerebellar peduncles.

The *inferior medullary velum* is a much more delicate structure than the superior, though, like it, consisting of white matter. Draw the medulla gently away from the cerebellum, and look for the roof of the lower part of the fourth ventricle. On the ventricular surface (anteriorly) it is obscured by the woolly-looking choroid plexus of the fourth ventricle, but its cerebellar (posterior) surface may be easily drawn away from the inferior vermis of the cerebellum by stroking it gently with a seeker.

It will be seen that this part of the roof, which is here formed by the inferior medullary velum, joins the superior medullary velum, and is attached with it to the cerebellum between the anterior ends of the upper and lower worms, thus resembling the apex of a tent.

Laterally, the inferior velum passes out to the flocculus, and its line of attachment is very easily seen on the side from which the medulla has been removed, as a stalk running from the flocculus to the front of the inferior worm, just below the cut cerebellar peduncles and above the tonsil.

This inferior medullary velum does not roof in all the lower half of the fourth ventricle, but ends below in a free edge. Below this the roof is only formed by the epithelial lining of the ventricle, in which are some openings to be looked for in the second brain.

The *inferior vermis* lies in the *valleeula cerebelli,* a deep notch between the two lower hemispheres of the cerebellum, and for this reason stands out much more distinctly than does the superior vermis. It is divided into several parts, the names of which are difficult to remember and of little practical interest (see Fig. 132).

The divisions of the *inferior surface of the cerebellum* are of no greater practical value than those of the inferior vermis when the position of the flocculus and tonsil have been noticed. The further subdivisions are interesting to the neurologist, but with an ever-lessening time available for the study of anatomy, the student cannot honestly be advised to learn them to the exclusion of other facts of greater practical importance (see Fig. 131).

Now make a median sagittal section through the cerebellum; this shows white matter in the interior, though it is not very plentiful. From this a number of branches radiate towards the periphery, each of which divides later into secondary, and these again into tertiary branches. In this way a tree-like pattern is formed (arbor vitæ), the tertiary branches being covered with grey matter and forming the *folia.*

Make another sagittal section through the lateral hemisphere of the cerebellum on the side from which the medulla has been removed and half an inch from the middle line. Notice in this how much greater the central core of white matter is than in the worm, and look for a deeply-crenated ring of grey matter embedded in it. This is the *corpus dentatum* [nucleus dentatus], the principal nucleus of the cerebellum.

The Floor of the Fourth Ventricle [Fossa Rhomboidea].—One-half of the medulla has already been removed

from the cerebellum. Replace this, and draw the half of the cerebellum remaining to one side. This will show the diamond-shaped FOURTH VENTRICLE, bounded above by the two superior cerebellar peduncles (Fig. 133).

Below it is bounded by the restiform bodies or inferior cerebellar peduncles, which seem to the naked eye to be continuous with two bundles on each side ascending from the posterior surface of the spinal cord.

The inner of these, continuous with the postero-medial columns (columns of Goll) in the cord, are known as the *funiculi graciles;* and when the lower apex of the fourth ventricle is reached, they swell up and form the *clavæ,* diverging at the same time from one another to open up the floor of the ventricle.

The outer of the two bundles on each side is continuous with the postero-lateral column of Burdach, and is called the *funiculus cuneatus;* it too has a slight swelling known as the *cuneate tubercle.*

The floor of the fourth ventricle is, as has been said, diamond-shaped, the upper angle being continuous with the aqueduct of Sylvius [aquæductus cerebri], by means of which it communicates with the third ventricle, while the lower angle, from its likeness to a nib, is known as the calamus scriptorius.

Running vertically down the mid line of the floor is the *median sulcus* through which the section has passed. Passing horizontally across the floor, from the middle of this groove to the lateral angles of the diamond, are strands of fibres known as the *striæ acusticæ,* belonging to the cochlear division of the auditory nerve, and, if these are followed outwards, they are seen to pass superficial to the restiform body.

These striæ divide the fourth ventricle into an upper and a lower triangle, and, on turning the specimen round, it will be seen that the upper triangle has the pons in front of it, while the lower has the medulla.

In the upper triangle or pontine part of the fourth ventricle a round swelling is seen on each side of the median sulcus; this is the *eminentia teres* [e. medialis], deep to which lies the nucleus of the sixth cranial nerve [nucleus n. abducentis] enclosed within a loop of the seventh. It is

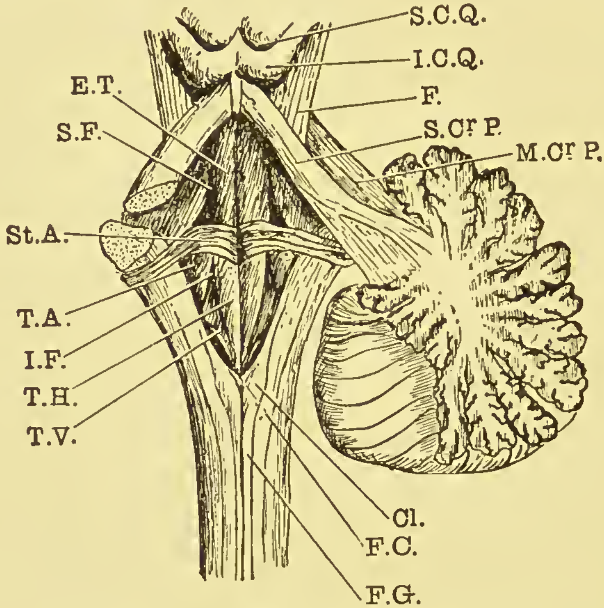


FIG. 133.—THE FOURTH VENTRICLE.

S.C.Q. Superior Corpora Quadrigemina. *I.C.Q.* Inferior Corpora Quadrigemina. *F.* Fillet. *S.Cr.P.* Superior Cerebellar Peduncle. *M.Cr.P.* Middle Cerebellar Peduncle. *Cl.* Clava. *F.C.* Funiculus Cuneatus. *F.G.* Funiculus Gracilis. *E.T.* Eminentia Teres. *S.F.* Superior Fovea. *St.A.* Striæ Acusticæ. *T.A.* Trigonum Acustici. *I.F.* Inferior Fovea. *T.H.* Trigonum Hypoglossi. *T.V.* Trigonum Vagi.

bounded externally by a small triangular depression, the *superior fovea,* and the upwardly-directed apex of this is continued into the *locus cœruleus,* so called from its faint slaty-blue colour.

Both these structures have deep to them part of the nucleus of the fifth cranial nerve.

In the lower or medullary triangle the *inferior fovea* on

each side is the most striking structure; its upwardly-directed apex reaches as high as the striæ acusticæ, while below it expands into a somewhat depressed triangle known as the *trigonum vagi*, since part of the vagus and glosso-pharyngeal nuclei lie deep to it.

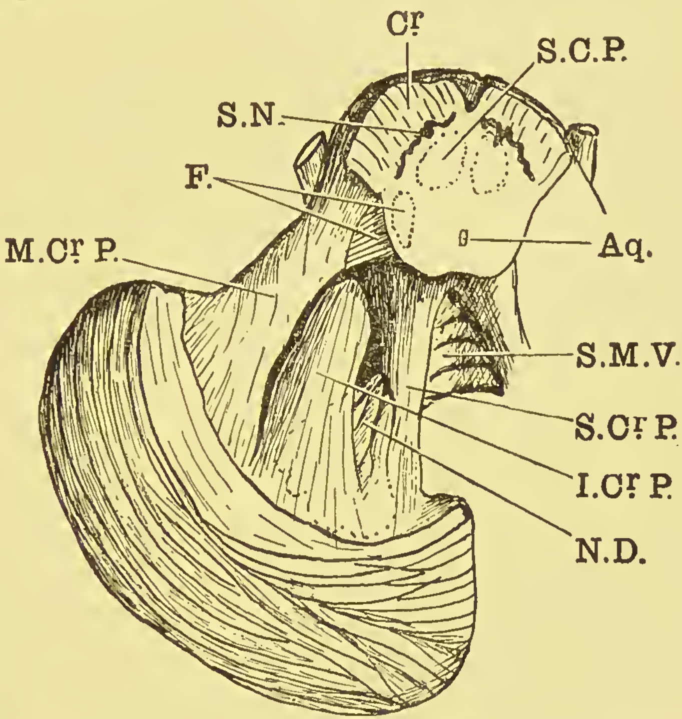


FIG. 134.—THE THREE CEREBELLAR PEDUNCLES DISSECTED FROM ABOVE.

M.Cr.P. Middle Cerebellar Peduncle. *I.Cr.P.* Inferior Cerebellar Peduncle. *S.Cr.P.* Superior Cerebellar Peduncle. *F.* Fillet. *S.N.* Substantia Nigra. *Cr.* Crusta. *S.C.P.* Superior Cerebellar Peduncle in Crus. *Aq.* Aqueduct of Sylvius. *S.M.V.* Superior Medullary Velum with Lingula. *N.D.* Corpus Dentatum.

Internally to the trigonum vagi, between it and the median sulcus, is the *trigonum hypoglossi* marking the position of the nucleus of the twelfth nerve, while externally to the trigonum vagi is the *trigonum acustici* covering the vestibular nucleus of the eighth nerve and forming part of

the area acustica. This area, however, is continued up above the striæ acusticæ into the pontine part of the fourth ventricle.

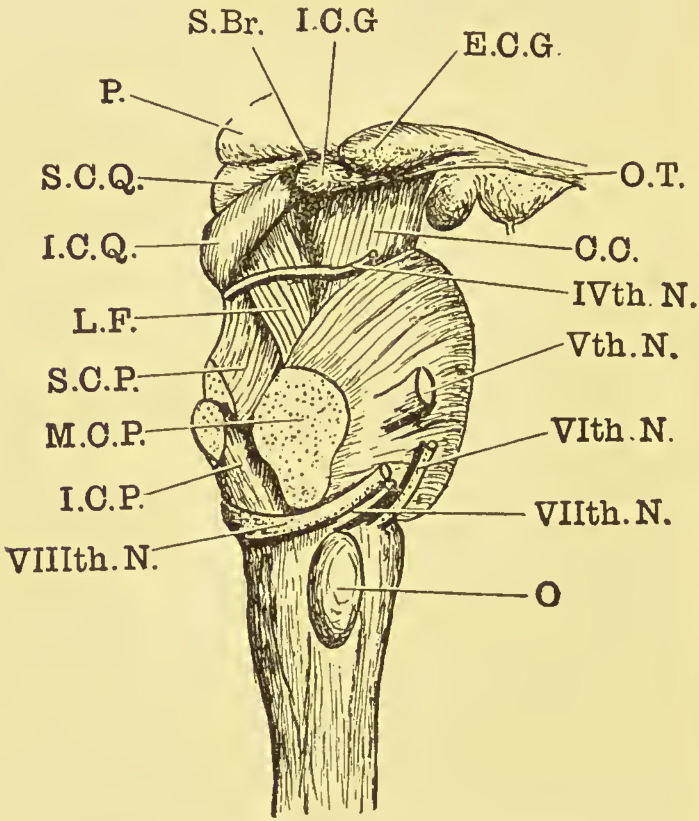


Fig. 135.—Cerebellar Peduncles and Fillet seen from the Side.

S.Br. Superior Brachium. *I.C.G.* Internal Corpus Geniculatum. *E.C.G.* External Corpus Geniculatum. *O.T.* Optic Tract. *C.C.* Crus Cerebri. *IVth, Vth, VIth, VIIth, VIIIth N.* The respective Cranial Nerves. *P.* Pulvinar. *S.C.Q.* Superior Corpus Quadrigeminum. *I.C.Q.* Inferior Corpus Quadrigeminum. *L.F.* Lateral Fillet. *S.C.P.* Superior Cerebellar Peduncle. *M.C.P.* Middle Cerebellar Peduncle. *I.C.P.* Inferior Cerebellar Peduncle. *O.* Olive.

It will be seen, therefore, that the medullary or lower half of the diamond-shaped fourth ventricle is divided into three triangles on each side, and that of these the inner and

outer (trigonum hypoglossi and trigonum acustici) have their apices downwards, while the intermediate trigonum vagi has its apex (inferior fovea) upwards.

It will be realised that the floor of the fourth ventricle is an important region functionally, since most of the cranial nerves from the sixth to the twelfth take their origin, in part at least, deep to it.

On the side of the cerebellum still attached to the medulla the three cerebellar peduncles may be followed into the interior of the cerebellum. It will then be noticed that the inferior (restiform body) becomes the middle of the three and bends very sharply back, the original middle peduncle (pons) becomes the external, while the superior has the innermost position, and enters the corpus dentatum (see Fig. 134). Between the superior and middle cerebellar peduncles the *lateral fillet* [lemniscus] is seen running up into the crus cerebri. Both it and the deeper *medial fillet* are important sensory paths from the opposite side of the cord (see Figs. 134 and 135).

The Medial Surface of the Cerebrum.—Separate the two cerebral hemispheres by a median vertical incision. To do this satisfactorily it is best to have the base of the brain upward and to use as long a knife as is available. As soon as the corpus callosum is divided, lift up the knife lest some of the convolutions be sliced off.

As soon as this is done, examine the *corpus callosum*, and notice that there is more of the brain behind than in front of it (see Fig. 136).

The anterior part, which is bent upon itself, is the *genu*, and this ends below in a point—the *rostrum*. Behind is the *splenium*, while the intermediate part is the *body* [truncus], and this, if the brain has been properly hardened, is distinctly convex upward.

Below the middle third of the corpus callosum is the *fornix*, but as this structure is traced forward it arches downwards and forwards and then downwards and backwards, until it is lost in the lower part of the brain point-

ing straight for the corpus albicans of its own side. It is from this marked arching that the fornix derives its name.

From its anterior convexity a thin membrane, the *septum lucidum* [s. pellucidum], stretches to the concavity of the corpus callosum.

This will probably only be seen on one side of the section,

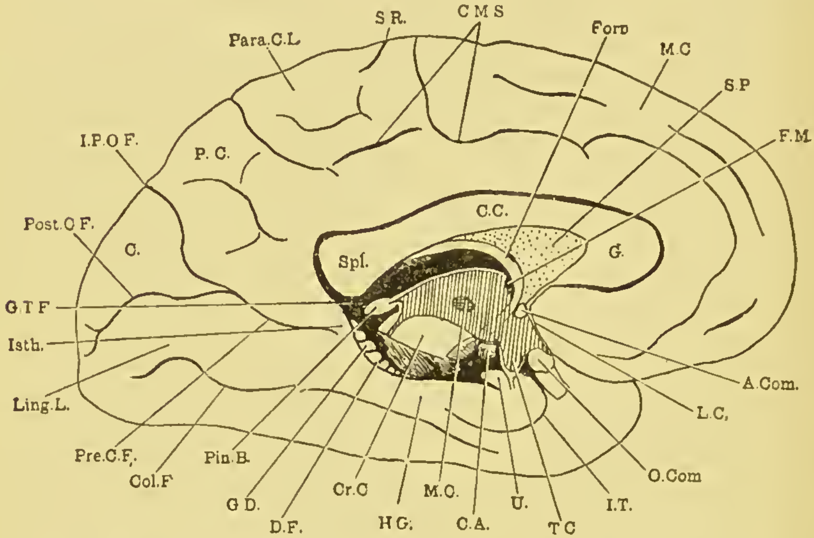


FIG. 136.—MEDIAL SAGITTAL SECTION OF THE CEREBRUM.

C.C. Corpus Callosum, surrounding which is the Callosal Gyrus. *G.* Genu. *Spl.* Splenium. *S.P.* Septum Pellucidum. *Forn.* Fornix. *F.M.* Foramen of Monro. *A.Com.* Anterior Commissure. *L.C.* Lamina Cinerea. *O.Com.* Optic Commissure. *T.C.* Tuber Cinereum. *C.A.* Corpus Albicans. *M.C.* Middle Commissure. *Cr.C.* Crura Cerebri. *Pin.B.* Pineal Body, from which the Stria Pinealis runs forwards to *F.M.*, and below which the Posterior Commissure is found. *G.T.F.* Great Transverse Fissure.

(The other letters, referring to the convolutions, are named on p. 311.)

while on the other side the lateral ventricle is exposed and the caudate nucleus seen.

Behind the fornix and at the most anterior part of its arch is the *foramen of Monro* [f. interventricularе], an oval aperture bounded by the fornix in front and the optic thalamus behind.

Just above it and forming its upper boundary is the tip of the tela chorioidea, to be noticed later.

A little below the foramen of Monro, but in front of the fornix, is the section of the *anterior commissure,* while the concavity of the fornix arches round the front of the *optic thalamus,* which is here forming the lateral wall of the third ventricle. The thalamus is joined to its fellow of the opposite side by the *middle* or *soft commissure,* which differs from the anterior in being formed of grey instead of white matter.

Where the fornix lies behind the anterior commissure its two *anterior pillars* [columnæ fornicis] have quite separated from one another, and the knife has passed between them; but above this point they converge, and where the corpus callosum and fornix come into contact the anterior pillars have joined one another to form the *body of the fornix,* which, of course, has been divided longitudinally.

Farther back the two halves of the fornix diverge again to form the *posterior pillars* [crura fornicis], and either of these may be traced downwards and backwards by drawing the corpus callosum and optic thalamus gently apart.

The Third Ventricle.—The section now being studied gives a good idea of the general shape of this cavity. It is little more than a median slit the lateral walls of which are formed by the optic thalami. It has in addition a roof, a floor, an anterior and a posterior wall.

The roof is formed by the reflexion of the pia mater, known as the *tela chorioidea* or *velum interpositum* (see Fig. 137, Ch.Pl.) which is pushed in from the back of the brain between the splenium and corpora quadrigemina. Its anterior end has been noticed as the upper boundary of the foramen of Monro, while laterally it is attached to the *stria pinealis* [habenula] on each side, a fine white band which lies at the junction of the roof and lateral wall of the ventricle, and may be traced back to the pineal body (see Fig. 136).

It should be clearly understood that the whole of the

third ventricle, like all the others except the fifth, is lined with ciliated epithelium (ependyma), though this, of course, cannot be seen with the naked eye. The pia mater (tela chorioidea), therefore, is only the apparent roof of the ventricle.

The floor begins in front as the *optic recess,* which projects

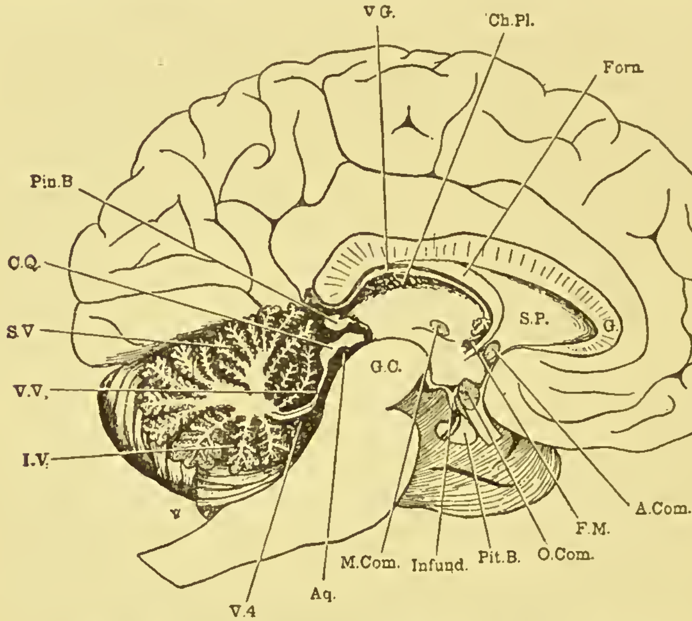


FIG. 137.—MEDIAL SECTION OF THE WHOLE BRAIN.

V.G. Vein of Galen. *Ch.Pl.* Tela Chorioidea, containing the Choroid Plexuses of the Third Ventricle. *Pit.B.* Pituitary Body. *Infund.* Infundibulum. *Aq.* Aqueductus Sylvii. *C.Q.* Corpora Quadrigemina. *V.* 4. Fourth Ventricle. *V.V.* Superior Medullary Velum. *S.V.* Superior Vermis. *I.V.* Inferior Vermis.

(Many of the letters are the same as in the last illustration, Fig. 136.)

downwards and forwards into the optic commissure, while behind this is another recess jutting down into the tuber cinereum and infundibulum. Farther back still are the corpora albicantia, and then the tegmental portion of the crura cerebri.

The posterior wall joins the floor at the opening of the aqueduct of Sylvius, above which the small *posterior white*

commissure should be looked for. Above this is the *pineal recess*, which runs backwards into the root of the pineal body, while still higher is the *supra-pineal recess*, lying between the pineal body and the splenium in the great transverse fissure of the brain.

The anterior wall of the third ventricle begins above at the foramen of Monro, where the roof of tela chorioidea ends;

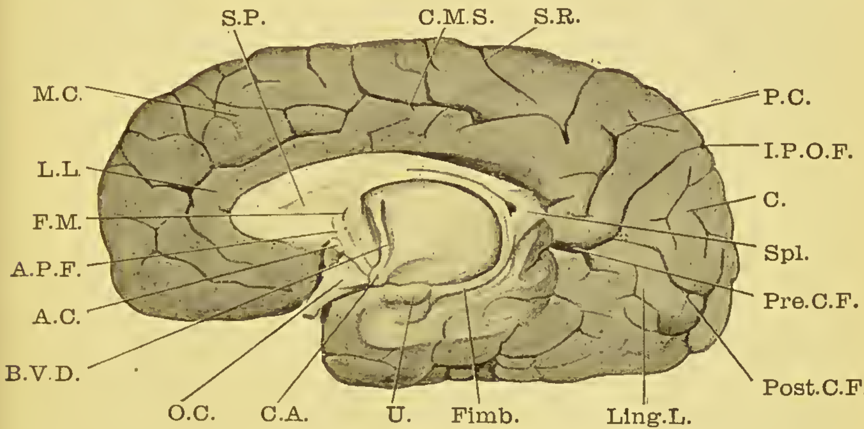


FIG. 138.—DISSECTION OF THE WHOLE COURSE OF THE FORNIX, AND PLAN OF MEDIAL CONVOLUTIONS.

S.P. Septum Pellucidum. *C.M.S.* Calloso-marginal Sulcus. *S.R.* Fissure of Rolando. *P.C.* Precuneus. *I.P.O.F.* Internal Parieto-occipital Fissure. *C.* Cuneus. *Spl.* Splenium. *Pre.C.F.* Pre-calcarine Fissure. *Post.C.F.* Post-calcarine Fissure. *Ling.L.* Gyrus Lingualis. *Fimb.* Fimbria. *U.* Uncus. *C.A.* Corpus Albicans. *O.C.* Optic Commissure. *B.V.D.* Bundle of Vicq d'Azyr. *A.C.* Anterior Commissure. *A.P.F.* Anterior Pillar of Fornix. *F.M.* Foramen of Monro. *L.L.* Limbic Lobe. *M.C.* Marginal Convolutions.

here the anterior pillars of the fornix form its front boundary, but, as these diverge, the anterior commissure and, below that, the lamina cinerea form the boundary.

The *section of the pineal body* should be carefully noticed, lying just above the superior corpora quadrigemina and closely attached to the reflexion or apparent invagination of the tela chorioidea.

With a little skill and patience the anterior pillar of the

fornix may be traced downwards and backwards into the corpus albicans of its own side. Here it seems to twist itself into a knot and to run up in the substance of the optic thalamus as the very distinct *bundle of Vicq d'Azyr* [fasciculus thalamo-mammillaris], which recedes into the substance of the thalamus as it ascends. There is, however, a break between the two bundles of fibres in the corpus albicans, though it is not evident to the naked eye (see Fig. 138).

The best method of exposure is to scrape the thalamus away with a blunt knife, when the bundle of Vicq d'Azyr may be traced as high as the level of the stria pinealis.

Convolutions of the Medial Surface

Surrounding the convex surface of the corpus callosum is the *callosal fissure* [sulcus corporis callosi], which separates that commissure from the *callosal gyrus* [g. cinguli] (see Fig. 138, L.L.). This gyrus begins below the rostrum of the corpus callosum and curves round its genu, body, and splenium. Below the latter it narrows to form the *isthmus* which connects it with the *gyrus hippocampi*, a convolution running forwards into the temporal lobe as far as the uncus and below the optic thalamus (see Fig. 139, H.G.).

In order to see all the relations of this region, the lower and back part of the lateral wall of the third ventricle, including the pineal body, superior corpus quadrigeminum, and crus cerebri should be carefully sliced away on one side. This allows the posterior pillar of the fornix to be traced downwards and forwards into the tip of the uncus or hook. In this part of its course the posterior pillar is known as the *fimbria* (see Fig. 138).

Just below the fimbria, between it and the hippocampal gyrus, is a narrow strand of grey matter with a crinkled or toothed appearance. This is the *dentate gyrus*, and is separated from the hippocampal gyrus by the *dentate fissure* (Fig. 139, G.D. and D.F.).

Just above the fimbria, between it and the optic thalamus (see Fig. 138), the tela chorioidea is pushed into the descending horn of the lateral ventricle, and contains the choroid plexus of that horn between its layers. When it is pulled out, the descending horn is opened and the gap through which the plexus has been withdrawn is the *choroid fissure*,

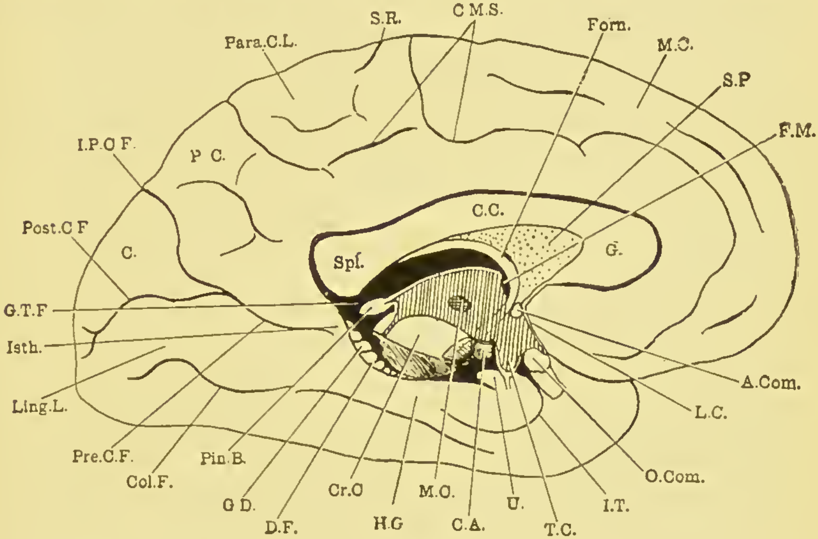


FIG. 139.—MEDIAL SAGITTAL SECTION OF THE CEREBRUM.

Isth. Isthmus. *H.G.* Gyrus Hippocampi. *U.* Uncus. *G.D.* Gyrus Dentatus. *D.F.* Dentate Fissure. *G.T.F.* Great Transverse Fissure, from which the Choroidal Fissure may be seen running downwards and forwards. *M.C.* Marginal Convolutions. *C.M.S.* Calloso-marginal Sulcus. *S.R.* Fissure of Rolando. *Para.C.L.* Para-central Lobule. *P.C.* Precuneus. *I.P.O.F.* Internal Parieto-occipital Fissure. *Post.C.F.*, *Pre.C.F.* Post- and Pre-calcarine Fissures. *C.* Cuneus. *Ling.L.* Gyrus Lingualis. *Col.F.* Collateral Fissure. *I.T.* Incisura Temporalis.

(The other letters, referring to the Third Ventricle, are named on p. 306.)

which is continuous with the *great transverse fissure*, the gap at the back of the brain lying below the splenium and above the corpora quadrigemina and pineal body. When viewed from behind it will be seen that this fissure, with its lateral continuations, the two choroid fissures, make a crescentic opening with its concavity downwards. It is all

along this that the pia mater is invaginated into the lateral ventricles to form the tela chorioidea containing the choroid plexuses between its two layers.

Now the LIMBIC LOBE [gyrus fornicatus] can be understood; it is composed of the callosal gyrus, the isthmus, the hippocampal gyrus, and the uncus, and would form a complete oval ring were it not for the vallecula Sylvii in front.

It must be remembered that the outer root of the olfactory tract passes into the uncus, while the inner joins the callosal gyrus, and so the rather happy simile of a tennis racket laid on its side has been suggested for the limbic lobe, the olfactory tract forming the handle of the racket.

The specimen at this stage illustrates not only the whole limbic lobe but the whole course of the fornix as seen from the mid line; indeed, the fornix, septum lucidum, and gyrus dentatus have been included in the limbic lobe by some anatomists.

The *marginal convolutions* lie nearer the margin of the brain than the callosal gyrus, from which they are separated by the *calloso-marginal sulcus* [s. cinguli]. This sulcus begins below the rostrum of the corpus callosum and winds round the genu to a point nearly vertically above the splenium. Here it turns upwards to the margin of the brain, and in many cases is seen to curve round the upper end of the central or Rolandic fissure, which often reaches this medial surface of the brain and runs for a little distance downwards and backwards.

This posterior inch of the marginal convolution, containing the medial continuation of the central fissure, is sometimes marked off from the rest by the continuation over the edge of the brain of the precentral sulcus, and is then known as the *paracentral lobule* (see Fig. 139).

Behind this paracentral lobule lies a square area called the *precuneus*, bounded posteriorly by the INTERNAL PARIETO-OCCIPITAL FISSURE, which is continuous with the external parieto-occipital on the outer surface of the brain. This

fissure runs downwards and a little forwards and joins the CALCARINE FISSURE, which is running nearly horizontally forwards.

Between them these two fissures mark off a wedge-shaped area known as the *cuneus*.

The junction of the internal parieto-occipital fissure with the calcarine divides the latter into *pre-* and *post-calcarine fissures*, and of these the pre-calcarine, which is the deeper of the two, runs forwards just below the isthmus and ends in the hippocampal gyrus, splitting the posterior end of this gyrus into an upper limb continuous with the isthmus and lower continuous with the gyrus lingualis.

Broadly speaking, the internal surface of the occipital lobe is the site of the higher visual centre.

This *gyrus lingualis* lies just below the whole length of the calcarine fissure, as far back as the occipital pole. The COLLATERAL FISSURE runs parallel to and below the calcarine, but is prolonged farther forward, thus forming the lower limit of the gyrus lingualis behind and of the hippocampal convolution in front. It generally ends below the front part of the last-named gyrus, from which the uncus curves back, and this part of the hippocampal gyrus, somewhat enlarged and often known as the *caput hippocampi*, is marked off anteriorly by the *incisura temporalis*, which has a backward concavity and occasionally runs into the collateral fissure.

Below the collateral fissure is the *inferior temporal gyrus*.

On turning the brain round it will now be noticed that there are five more or less distinct longitudinal gyri in the temporal lobe which are numbered from the Sylvian fissure.

The first, second, and third are seen on the external (lateral) surface of the brain, the second, third, and fourth on the inferior surface, while the fourth and fifth are on the internal (medial) surface. The fifth is the hippocampal gyrus between the collateral and dentate fissures, and so, strictly speaking, part of the limbic rather than the temporal lobe (see section of brain on p. 340).

The Membranes of the Brain

Now that the whole surface of the brain has been studied, it will be easy to understand the relations of the membranes and vessels.

For this purpose the second brain should be used, the arteries of which have, if possible, been injected, though this is not absolutely necessary.

The first brain, which has hitherto been worked with, should be kept at hand for reference.

The Arachnoid Membrane [arachnoidea encephali] is continuous with that covering the cord, but invests the brain more closely. The subdural space, which lies outside it, has already been noticed with the dura mater (p. 61).

At the base of the brain are several large spaces separating the arachnoid from the pia mater and known as cisternæ.

One of the most important of these, the *cisterna basalis* [c. interpeduncularis], occupies the interpeduncular space. Notice how the optic nerves emerge from the front of this, and have a distinct sheath of the arachnoid surrounding them.

Just behind these the internal carotid arteries enter the space, while, farther back and a little more laterally, the third nerves are seen, but the arachnoid sheaths of these and of the other cranial nerves, unlike those of the optic, very soon blend with the coat of the nerves.

Open the cisterna, and notice the thread-like trabeculæ which stretch across it, and are so characteristic of the subarachnoid space in which the cerebro-spinal fluid is contained. Antero-laterally the space projects like two horns into the valleculæ Sylvii, forming the *cisternæ Sylvii* [c. fossæ lateralis cerebri].

Posteriorly the cisterna basalis is continued into the *cisterna pontis*, lying beneath and in front of the pons and medulla, and so becomes continuous with the spinal subarachnoid space. Try to identify the various cranial nerves from the fourth to the twelfth emerging from it.

On each side of the medulla the cisterna pontis communicates with the *cisterna magna* [c. cerebello-medullaris], which occupies the space between the fourth ventricle and the inferior surface of the cerebellum.

If the arachnoid has not already been torn here, open it very carefully and examine the roof of the fourth ventricle near its lower part for the foramen of Majendie [apertura medialis ventriculi quarti].

On each side of the medulla look for the cut vertebral arteries.

The cisterna pontis, when it is opened, may also be followed round the crura cerebri, on each side, to the region of the great transverse fissure, where the *cisterna venæ magnæ cerebri* lies just behind and below the splenium of the corpus callosum.

In all these cisterns the space between the arachnoid and pia mater is considerable, the trabecular network is loose and delicate, while the great vessels and the beginning of all the cranial nerves lie among its meshes surrounded by the cerebro-spinal fluid. On the surface of the brain, however, the arachnoid is fairly closely connected to the subjacent pia mater at the convexities of the convolutions, while between the convolutions there is a series of spaces in which the blood vessels lie, and the trabeculæ become finer again. These spaces form a network of rivers (flumina), which eventually open into the cisternæ.

The Pacchionian bodies on the surface of the arachnoid have already been considered (see p. 61).

The Pia Mater of the brain [p.m. encephali] differs a good deal from that of the spinal cord, since it is reflected into all the sulci either as a single or a double layer, while at the great transverse fissure and its continuations, the choroidal fissure of each side, it is pushed into the interior of the brain, enclosing the choroid plexuses of veins and forming the *tela chorioidea* or *velum interpositum.*

The smaller cerebral and cerebellar arteries and veins are

embedded in the pia mater just before entering or just after leaving the brain.

In cleaning the first brain the dissector will have acquired a good deal of practical experience of the pia mater, but it should be remembered that opposite the convexity of the convolutions the pia mater and arachnoid are really confluent.

The Vessels of the Brain

The *cerebral veins* for the most part open into the superior longitudinal sinus, though some pass down into the lateral and cavernous sinuses. They are very thin-walled, and mainly lie in the superficial part of the sulci, while the cerebral arteries lie deeper. Their peculiar mode of entering the superior longitudinal sinus has already been noticed (see p. 61).

The Circle of Willis [circulus arteriosus] should now be exposed by freely opening up the cisterna basalis and cisterna pontis. Notice how the internal carotid artery lies in the concavity formed by the optic nerve and optic tract on each side; here it is usually joined by the posterior *communicating artery* from the posterior cerebral, and then at once gives off the *anterior choroidal artery*, which runs back parallel and just external to the optic tract, to enter the choroid fissure and so reach the choroid plexus of the descending horn of the lateral ventricle.

After giving off this branch, the internal carotid divides into anterior and middle cerebral arteries.

The *anterior cerebral artery* of each side runs forwards and inwards to the beginning of the longitudinal fissure, giving off the *antero-medial ganglionic branches*, which go through holes in the inner part of the anterior perforated space between the roots of the olfactory tract. These, like all the other ganglionic branches, are "end arteries," and never anastomose with one another, so that if one is blocked the area of brain to which it is distributed is irrevocably cut off from all blood.

When the two anterior cerebrals come close together in the longitudinal fissure they are connected by the short *anterior communicating artery.* After this each supplies

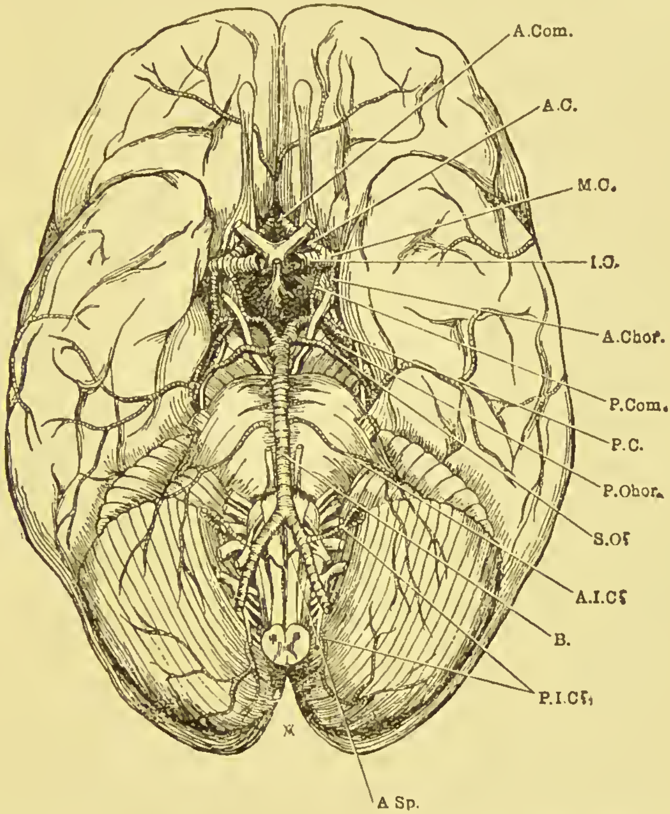


FIG. 140.—THE ARTERIES OF THE BASE OF THE BRAIN.

A.Com. Anterior Communicating. *A.C.* Anterior Cerebral. *M.C.* Middle Cerebral. *I.C.* Internal Carotid. *A.Chor.* Anterior Choroidal. *P.Com.* Posterior Communicating. *P.C.* Posterior Cerebral. *P.Chor.* Posterior Choroidal. *S.Cr.* Superior Cerebellar. *A.I.Cr.* Anterior Inferior Cerebellar. *B.* Basilar. *P.I.Cr.* Posterior Inferior Cerebellar. *A.Sp.* Anterior Spinal.

the internal orbital convolution, and, turning round the genu of the corpus callosum, gives blood to the medial surface of the brain as far back as the junction of the middle and posterior thirds of the precuneus (see Fig. 142).

Some branches also turn over the upper margin of the brain to supply a narrow strip of the lateral surface (see Fig. 141).

It should be particularly noticed that all these cortical branches, unlike the ganglionic, anastomose very freely with one another.

The *middle cerebral artery* of each side runs outwards into the vallecula Sylvii. By pulling back the temporal pole the *antero-lateral ganglionic branches* will be seen going into holes in the lateral part of the anterior perforated space. One of the outermost of these is said to be larger than the rest, and is known as the "artery of cerebral hæmorrhage."

Soon after this the middle cerebral artery divides into four branches, which are arranged fanwise between the gyri of the insula, and supply all the lateral (external) surface of the brain except the superior frontal convolution, the strip along the upper margin of the brain already accounted for by the anterior cerebral artery, the occipital lobe and a strip along the lower margin of the temporal lobe which the posterior cerebral supplies.

Now follow the two *vertebral arteries* forward. In the dissection of the spinal cord (p. 24) these arteries were seen passing through the foramen magnum, having already pierced the dura mater and arachnoid. They now run obliquely forwards and upwards, lying at first on the outer side of the medulla and then in front of it, till at the lower margin of the pons they unite to form the basilar artery. In their course they pass between the origins of the hypoglossal and first cervical nerves.

Of their branches the posterior spinal and posterior meningeal have been noticed already (p. 24). The *posterior inferior cerebellar* is usually the next, as it is always the largest branch of the vertebral. Trace it outwards and backwards to the deep notch on the under surface of the cerebellum (vallecula cerebelli), where it will be seen to divide into an outer branch for the lateral lobe of the cerebellum, and an inner for the inferior vermis.

The *anterior spinal artery* is generally the last branch of the vertebral, and soon joins its fellow of the opposite side to form the single median artery already studied. It is usually much larger on one side than on the other.

The *basilar artery* is about an inch long, and corresponds to the depth of the pons, lying in the slight mid-ventral groove

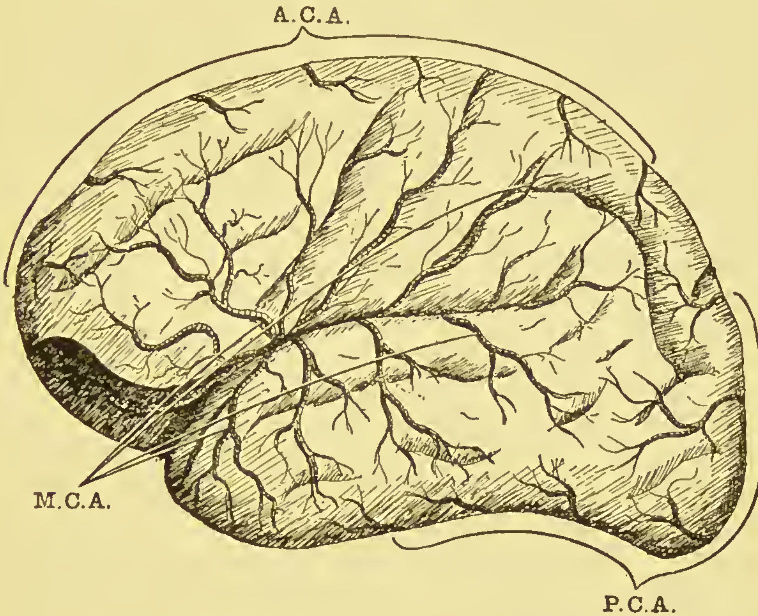


Fig. 141.—Arteries of Lateral Surface of Cerebrum.

A.C.A. Area of Anterior Cerebral. *M.C.A.* Area of Middle Cerebral. *P.C.A.* Area of Posterior Cerebral.

of that structure and enclosed in the cisterna pontis. It gives off a number of transverse branches to the pons, as well as a delicate *auditory artery* [a. auditiva interna] to the internal auditory meatus (see Fig. 140).

The *anterior inferior cerebellar artery* also comes off the trunk of the basilar and runs outwards to the front of the inferior surface of the cerebellum. Sometimes it does the work of the posterior inferior cerebellar artery as well.

When the upper border of the pons is reached, the basilar

artery divides into four branches, the two superior eerebellar and the two posterior eerebral arteries.

The *superior cerebellar artery* of eaeh side runs outwards and baekwards round the erus eerebri, just below the free edge of the tentorium eerebelli and the fourth nerve. When the upper surface of the eerebellum is reaehed it divides, like the posterior inferior eerebellar, into internal or vermian, and external or hemispherie branehes.

The *posterior cerebral artery* runs parallel with and just in front of the superior eerebellar to the internal (medial) surfaces of the temporal and oecipital lobes of the cerebrum, but separated from the latter artery by the third and fourth nerves.

Each posterior eerebral artery at first has a slight forward eonvexity, at the most anterior point of which the posterior eommunicating artery joins it to the internal earotid, to eomplete the circle of Willis.

These *posterior communicating trunks* often differ in size on the two sides, and sometimes are absent altogether.

At the very beginning of the posterior eerebral artery look for the *postero-median ganglionic branches* going through the posterior perforated spaee, and farther on for some *postero-lateral ganglionic branches* to the eorpora genieulata and eorpora quadrigemina.

When the main trunk has reaehed the under surfaee of the splenium by curving round the erus eerebri, it gives off the *posterior choroidal artery* through the great transverse fissure to the ehoroid plexus of the body of the lateral, as well as to that of the third ventriele.

From its outer side, as it passes baek, the posterior eerebral gives off temporal branches to the medial surfaee of the temporal lobe, and finally ends in oeeipital twigs, whieh, of eourse, must not be eonfused with the oceipital artery outside the skull (see Fig. 142).

Now take a last general survey of the blood supply of the brain, and notice that the outer (lateral) side of the cerebrum

is supplied almost entirely by the middle cerebral, while of the inner (medial) side about two-thirds is the anterior cerebral area and one-third posterior cerebral, the middle cerebral only supplying the tip of the temporal lobe on this aspect.

The interior of the cerebrum is supplied by antero-medial ganglionic branches from the anterior cerebral,

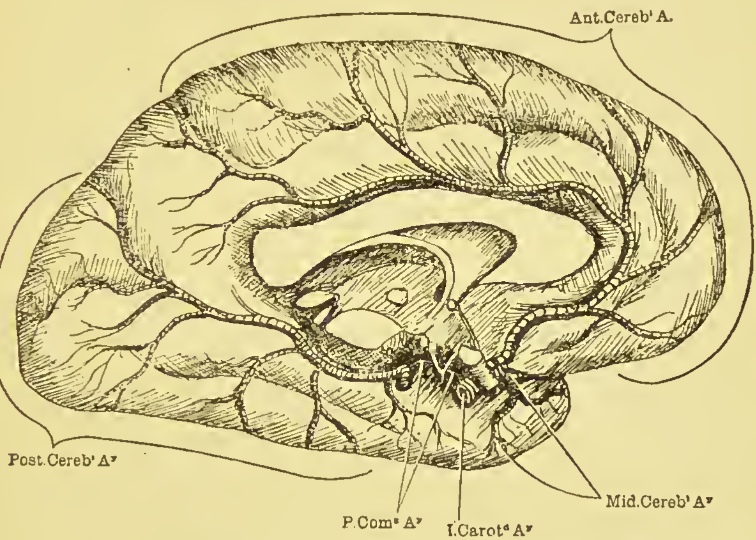


FIG. 142.—DISTRIBUTION OF ARTERIES ON THE MEDIAL SURFACE OF THE CEREBRUM.

Ant.Cereb^l.A. Anterior Cerebral Artery. *Post.Cereb^l.A.* Posterior Cerebral Artery. *Mid.Cereb^l.A.* Middle Cerebral Artery. *I.Carot^d.A^y.* Internal Carotid Artery.

antero-lateral from the middle cerebral, postero-medial and postero-lateral from the posterior cerebral.

The choroid plexus of the descending horn of the lateral ventricle derives its blood from the anterior choroid branch of the internal carotid, while that of the body of the lateral ventricle and of the third ventricle receive theirs from the posterior choroid branch of the posterior cerebral.

The upper (tentorial) surface of the cerebellum has one

artery, the superior cerebellar from the basilar, to supply it, while the lower surface has two, the anterior and posterior inferior cerebellar, the former from the basilar, the latter from the vertebral.

THE EXPOSURE OF THE CORPUS CALLOSUM FROM ABOVE.—Draw the two cerebral hemispheres apart, and notice the upper surface of the corpus callosum acting as a great bridge between them (this body has already been studied in sagittal section on p. 305).

Quite close to the mid line on each side is a white longitudinal stripe (*stria longitudinalis medialis*); while if one hemisphere be forcibly pulled aside, another stripe, formed of grey matter (*stria longitudinalis lateralis*), comes into view.

The next thing is to understand what the corpus callosum does when it enters the brain.

To do this, take a long brain knife and slice the top of the brain off horizontally half-way down to the level of the top of the corpus callosum. Notice the mass of white matter (*centrum ovale minus*), in the middle of each hemisphere, surrounded by the superficial grey cortex, which lines all the gyri and sulci, and averages some fifth of an inch in thickness.

Take another horizontal slice on one side only at the level of the upper surface of the corpus callosum. It is quite possible that this will open the lateral ventricle, because the corpus callosum forms its roof, and runs upwards and outwards on each side into the central mass of white matter, which is here known as the *centrum ovale majus* (see Fig. 149, θ).

On the other side of the brain, remove the callosal convolution by breaking it carefully outwards from above the corpus callosum, and look at the upper surface of the latter.

Its fibres will now be seen running outwards as the *tapetum*, while those coming from the genu pass forwards and outwards to form, when the two sides are exposed, the *forceps minor*.

In the same way the fibres from the splenium run back-

wards and outwards and then backwards and inwards to form the *forceps major*.

Now look carefully at the lower surface of the piece of brain, which was broken away in exposing the corpus callosum, for a band of fibres running antero-posteriorly and slightly embedded in the roof of the callosal fissure. This is the *cingulum*, and it is generally torn close to the genu and splenium of the corpus callosum. It was formerly regarded as an "association tract" linking up different parts of the brain, but the more modern view is that it is chiefly a "projection tract," carrying fibres from the medial surface of the cortex towards the medulla in front of and behind the corpus callosum.

The Lateral Ventricle

Make an antero-posterior cut through the corpus callosum just outside the median stria longitudinalis, or two or three millimetres from the mid line. Through the cut push the handle of a scalpel, and, using this as a seeker and guide, gradually cut away the corpus callosum or roof of the lateral ventricle until a good view of the cavity is gained.

On referring to the medial section of the brain (p. 308), it is obvious that the fornix lies very close below the corpus callosum posteriorly, while anteriorly it curves downwards and forwards, leaving a considerable interval between the two structures. The thin sharp lateral edge of the fornix must therefore be identified forming the inner part of the floor of the lateral ventricle, and curving outwards and downwards posteriorly as the posterior pillar.

To get a good idea of the fornix from above, the opposite lateral ventricle should be opened in the same way as the first, leaving only a very narrow strip of the corpus callosum with its median longitudinal striæ in the middle line.

Now the two posterior pillars of the fornix are seen diverging, and each curving round to disappear in the

descending horn of the ventricle. They are connected by a very delicate layer of transverse fibres, and to this region the name of the *lyra* is given, from its likeness to the musical instrument of that name.

Appearing from under cover of the outer edge of the

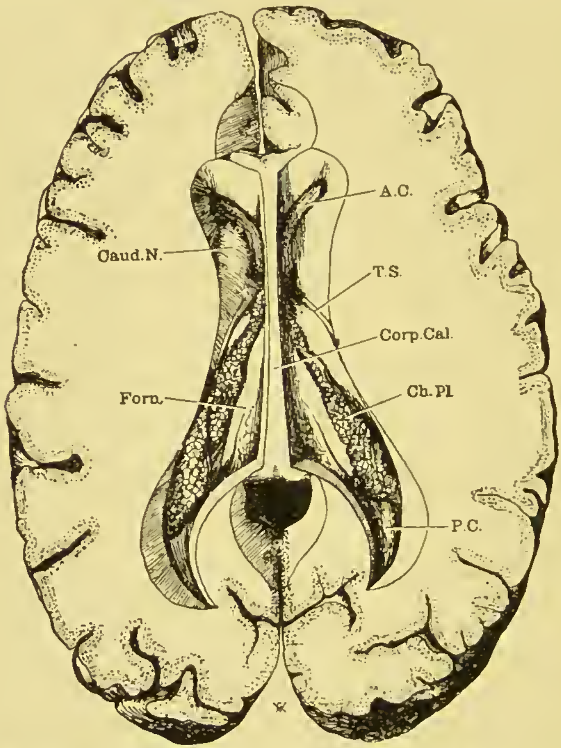


FIG. 143.—DISSECTION TO EXPOSE THE LATERAL VENTRICLES WITH THEIR CHOROID PLEXUSES.

A.C. Anterior Horn. *Caud.N.* Head of Caudate Nucleus. *T.S.* Tænia Semicircularis. *Corp.Cal.* Corpus Callosum. *Forn.* Fornix. *Ch.Pl.* Choroid Plexus. *P.C.* Posterior Horn.

fornix is the vascular, fringe-like *choroid plexus*, which may be traced forwards and downwards to the foramen of Monro, where the fornix is narrow.

Cut the fornix and remains of the corpus callosum across at their highest point, and turn the posterior part, including the lyra, carefully back, when the whole of the

triangular flap of the *tela chorioidea* (velum interpositum) will be seen with the choroid plexuses lying along its two margins.

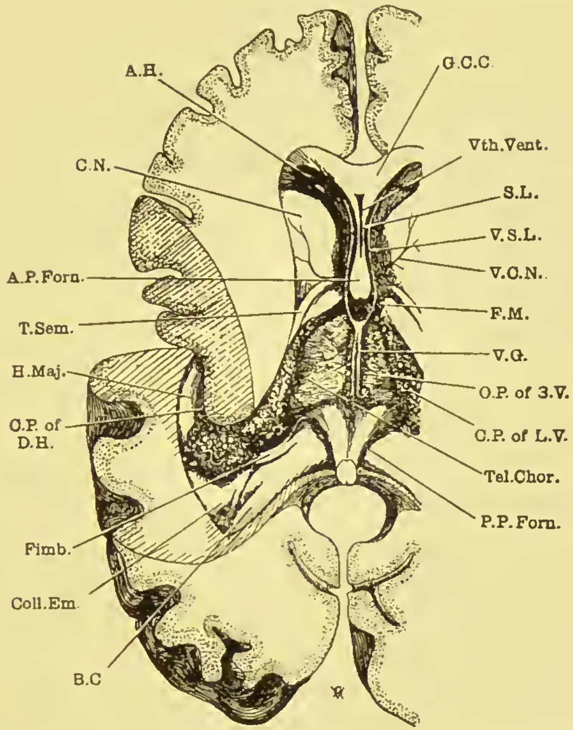


FIG. 144.—DISSECTION OF THE BRAIN TO SHOW THE CHOROID PLEXUSES.

A.H. Anterior Horn of Lateral Ventricle. *G.C.C.* Genu of Corpus Callosum. *C.N.* Caudate Nucleus. *Vth. Vent.* Fifth Ventricle. *S.L.* Septum Lucidum. *V.S.L.* Vein of Septum Lucidum. *V.C.N.* Vein of Caudate Nucleus. *A.P.Forn.* Anterior Pillar of Fornix. *F.M.* Foramen of Monro. *T.Sem.* Tænia Semicircularis. *V.G.* Veins of Galen. *C.P. of* 3. *V.* Choroid Plexus of 3rd Ventricle. *C.P. of L.V.* Choroid Plexus of Lateral Ventricle. *H.Maj.* Hippocampus Major. *C.P. of D.H.* Choroid Plexus of Descending Horn. *Tel.Chor.* Tela Chorioidea. *P.P.Forn.* Posterior Pillar of Fornix. *Fimb.* Fimbria. *Coll.Em.* Collateral Eminence. *B.C.* Bulb of the Cornu.

It will now be realised how the pia mater covering the back of the brain is apparently pushed forward as a sac-like double layer below the splenium of the corpus callosum and

above the corpora quadrigemina, through the great transverse fissure as far forward as the foramen of Monro.

It will also be easily understood that the veins in the choroid plexuses are between the two layers of the tela chorioidea, and so really outside the pia mater. When the development of the brain is studied, it will be seen that the double layer of the tela chorioidea is really due to the backward growth of the cerebral hemispheres.

It must also be realised that the choroid plexuses are covered by the delicate ciliated lining membrane or ependyma of the ventricles.

All that part of the lateral ventricle in front of the foramen of Monro is known as the *anterior horn*, and the roof of this should be removed after carefully exploring the cavity with some very blunt implement.

It will be found that the anterior horn runs downwards and outwards as well as forwards, and is compressed from side to side (see Fig. 150, p. 338). Its passage into the body of the ventricle is so gradual that, were it not for the foramen of Monro, it would be impossible to say where the anterior cornu began.

Notice that the two anterior horns are separated by a very thin partition, the *septum lucidum* or *pellucidum*, which has already been seen in the medial section (see p. 306).

This is still attached to a strip of the corpus callosum, which may now be cut away, and, in dividing the septum lucidum to do so, it will be seen that the latter consists of two layers enclosing the slit-like fifth ventricle between them (see Fig. 144).

This *Fifth Ventricle* [cavum septi pellucidi] should be explored with a seeker, when it will be found to have no outlet whatever, and therefore cannot contain cerebro-spinal fluid like the other ventricles, since there is no point of entry for it. Moreover, the space is not lined with ependyma as are the other ventricles.

The fifth ventricle therefore is clearly no part of the ventricular system of the brain, in spite of its name, and modern anatomists are trying to emphasise this fact by calling it the *cavum septi pellucidi.*

The outer surface of the anterior horn of each lateral ventricle is formed by the bulging head of the *caudate nucleus of the corpus striatum,* which is generally crossed by a vein running towards the foramen of Monro.

As the body of the ventricle is reached, the caudate nucleus rapidly narrows, until by the time it comes to the descending horn it is only a thin tail. As it is seen lying in the anterior horn and body of the lateral ventricle, the caudate nucleus looks like the quadrant of a pear with the stalk directed backwards.

Internal to the caudate nucleus is the convex outline of the *optic thalamus,* but this only forms a part of the floor of the body of the lateral ventricle, and so is altogether behind the foramen of Monro.

Between the optic thalamus and caudate nucleus runs a thin, strap-like, white band, known as the *tænia semicircularis* [stria terminalis], which anteriorly passes down below the foramen of Monro to join, at least in part, the anterior pillar of the fornix, while posteriorly the strand is seen dipping down into the descending horn with the tail of the caudate nucleus.

In close relation to the tænia semicircularis is the *vein of the corpus striatum* (*vena terminalis*), which runs down to the region of the foramen of Monro, where it receives the vein, already noticed, from the head of the caudate nucleus and another one from the septum lucidum, close to the anterior part of the choroid plexus, which here communicates with its fellow of the opposite side and forms the roof of the foramen.

From this point the blood is carried back by the *veins of Galen* [vv. cerebri internæ], which lie side by side between the layers of the tela chorioidea (see Fig. 144) and therefore

below the fornix, to the great transverse fissure of the brain, where the two veins unite to form the *great vein of Galen* [v. magna cerebri] and so pass to the straight sinus.

If the turned-back fornix is now replaced, it will be seen that the body of the lateral ventricle is triangular in section, though the triangle is much compressed from above downwards. Its roof is the corpus callosum which has been cut away; its floor, from without inwards, the caudate nucleus, tænia semicircularis, optic thalamus, choroid plexus and fornix; while its narrow base is the place where the fornix is attached to the corpus callosum (see Fig. 151, ζ).

Into the cavity of the ventricle the choroid plexus bulges from below the edge of the fornix, and at the foramen of Monro the lateral ventricle is able to communicate with its fellow of the opposite side as well as with the third ventricle.

Next determine the extent and direction of the posterior horn of the lateral ventricle with a seeker, and then open it up by removing thin horizontal slices of the occipital lobe. Localise the internal parieto-occipital fissure, and notice that the horn curves round this, at first passing backwards and outwards and then backwards and inwards, so that, when the two horns are displayed, they resemble the handles of a pair of pliers (see Fig. 143, P.C.).

The fibres of the forceps major form a convexity on the inner wall, known as the *bulb of the posterior horn*, and this must not be mistaken for the *hippocampus minor* or *calcar avis*, which is another and usually less well-marked swelling on the inner wall, corresponding to the anterior part of the calcarine fissure on the medial surface of the brain. It lies below the bulb, and varies a good deal in its development in different brains.

The descending horn of the lateral ventricle is seen running downwards and outwards from the junction of the body and posterior horn. The tail of the caudate nucleus and the tænia semicircularis have been noticed disappearing

down its anterior wall, while the posterior pillar of the fornix is seen on its inner and posterior aspect.

With the fornix the choroid plexus is continued down into the cornu.

Between the descending and posterior horn there is a triangular space on the floor of the ventricle known as the *trigonum ventriculi* [trigonum collaterale].

The whole extent of the cavity of the descending horn should be explored with a bent probe or seeker, and it will then be found that the cavity, after sinking downwards and outwards, turns forwards and inwards in the temporal lobe and ends blindly an inch to an inch and a half from the temporal pole.

It is best exposed from the outer side by passing a knife along the probe into the cavity, and then cutting outwards to the surface along the line of the parallel fissure. After this enough of the temporal lobe may be cut away to see the structures lying in the descending horn (see Fig. 144).

It should, however, be remembered that this horn has already been opened from the inner (medial) side in the first brain when the convolutions on the medial aspect were being studied. After stripping the pia mater off the surface of the hippocampal convolution, the choroid plexus was dragged out through the choroid fissure and thus the ventricle was opened.

It is evident, therefore, that the descending horn lies very much nearer the medial than the lateral part of the temporal lobe (see Fig. 152).

The most important structure in the descending horn is the *hippocampus major*, which corresponds to the inpushing of the dentate fissure. It begins behind the posterior pillar of the fornix as the latter is dropping down, and rapidly enlarges as it runs forwards along the floor until it ends in front as the *pes hippocampi* [digitationes hippocampi], which resembles an animal's paw, since it has three digits distinctly marked out by vertical grooves.

On its inner side lies the *fimbria*, which is the continuation of the posterior pillar of the fornix running forwards to the uncus (see p. 309), but some of the fornix fibres spread out over the hippocampus major and are known as the *alveus*. The fornix here is sometimes called tænia hippocampi.

The choroid plexus of the descending horn has been

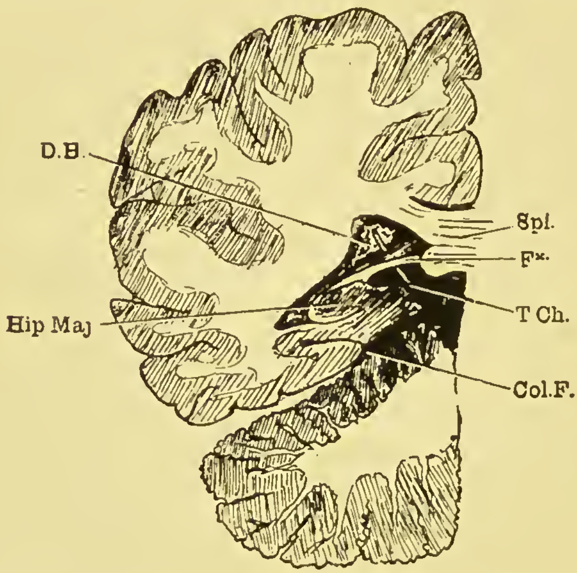


FIG. 145.—CORONAL SECTION THROUGH THE LEFT HALF OF THE BRAIN WHERE THE DESCENDING CORNU IS DROPPING DOWN FROM THE BODY OF THE LATERAL VENTRICLE.

Spl. Splenium. *Fx.* Posterior Pillar of Fornix, passing down to *Hip.Maj.* The Hippocampus Major. *T.Ch.* A rod passed in front of the Fornix to show how the Tela Chorioidea passes into the Lateral Ventricle through the Great Transverse Fissure to enclose the Choroid Plexus (*D.H.*). *Col.F.* Collateral Fissure.

found continuous with that of the body of the lateral ventricle; it is, of course, continued between two layers of the pia mater invaginated into the cavity at the choroid fissure, and is, moreover, covered by the ciliated ependyma lining the ventricle.

As the pes hippocampi is approached the choroid plexus

gradually fades away, and in front of its termination some observers say that there is a delicate slit-like opening through the pia mater, by means of which the tip of the cavity of the inferior horn is able to communicate with the subarachnoid

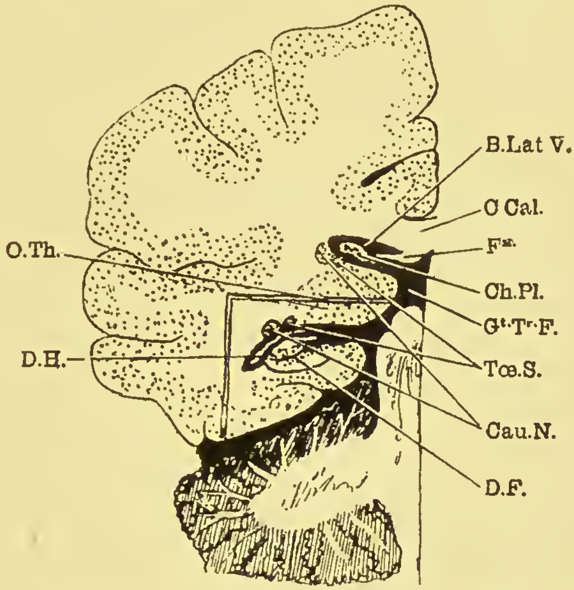


Fig. 146.—Coronal Section of the Left Half of the Brain to show the Relation of the Descending Horn to the Body of the Lateral Ventricle.

(The key to the position of this section will be found in Fig. 137, p. 308, where the line *V.G.* practically corresponds to it.)

B.Lat.V. Body of Lateral Ventricle. *D.H.* Descending Horn of Lateral Ventricle. *O.Th.* Optic Thalamus. *C.Cal.* Corpus Callosum. *Fx.* Fornix. *Ch.Pl.* Choroid Plexus. *Gt.Tr.F.* Great Transverse Fissure. *Tœ.S.* Tænia Semicircularis. *Cau.N.* Caudate Nucleus. *D.F.* Dentate Fissure.

(The area marked off is enlarged in the next figure.)

space in the cisterna basalis. It is, however, very doubtful whether this really exists.

It should be realised that the choroid plexus is always on the concave side of the fornix; in the body of the ventricle it appears below that structure; as the descending

horn is sinking down, the plexus is in front of the posterior pillar, while, when the horn runs forwards, the plexus lies above the fimbria.

Now follow the tail of the caudate nucleus, with the tænia semicircularis on its inner side, into the roof of the

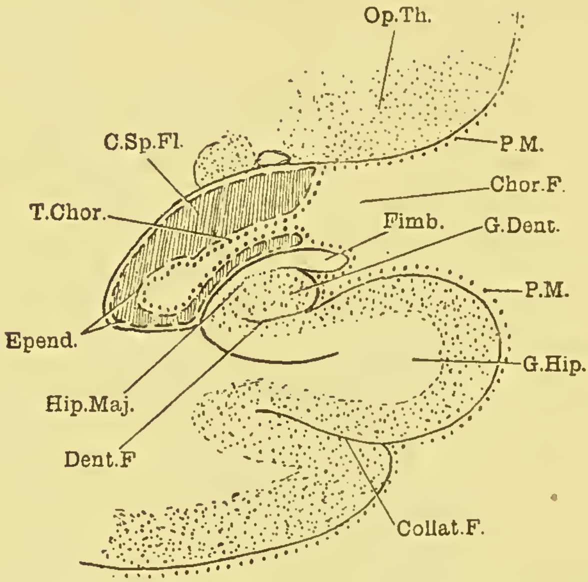


Fig. 147.—Enlargement of the Area marked off in Fig. 146, to show the Construction of the Descending Horn of the Lateral Ventricle.

Op.Th. Optic Thalamus. *P.M.* Pia Mater (dotted line). *Epend.* Ependyma (broken line). *C.Sp.Fl.* Cavity of the Ventricle containing the Cerebro-spinal Fluid. *T.Chor.* Tela Chorioidea invaginated through the Choroid Fissure (*Chor.F.*) into the Ventricular Horn. *Fimb.* Fimbria. *G.Dent.* Gyrus Dentatus. *Hip.Maj.* Hippocampus Major. *Dent.F.* Dentate Fissure. *G.Hip.* Gyrus Hippocampi. *Collat.F.* Collateral Fissure.

descending horn, and notice how they both end in a mass of grey matter there which is known as the *amygdaloid nucleus* (see Fig. 150). Just internal to them, as they are passing forward, the external geniculate body should be identified as it forms part of the upper lip of the choroid fissure.

There is one more swelling in the descending horn to be

looked for; it is the *collateral eminence*, and lies in the floor on the outer side of the hippocampus major. It corresponds to the inpushing of the collateral fissure, and is best seen just in front of the trigonum ventriculi.

Structures Embedded in the Substance of the Cerebral Hemispheres

Remove the tela chorioidea and choroid plexuses from the bodies of the lateral ventricles. In doing this the roof of the third ventricle will necessarily be opened. Notice that it is only the attachment of the tela chorioidea to the optic thalamus on each side, with, of course, its covering of ependyma, which prevents the third ventricle from communicating all along the sides of its roof with the lateral ventricles.

As it is, the communication is only possible where the tela chorioidea stops at the foramen of Monro.

Notice too that there are two delicate longitudinal fringe-like folds hanging down into the third ventricle from its roof, the lower surface of the tela chorioidea. These are the *choroid plexuses of the third ventricle.* Take the long knife and make a section as nearly horizontal as possible through one hemisphere in such a way that it passes through or just above the foramen of Monro and also just above the pineal body.

The cut caudate nucleus and optic thalamus will be easily recognised, but, to the outer side of them, there is another mass of grey matter, triangular in this section, with its apex directed inwards. This is the *lenticular nucleus of the corpus striatum* [n. lentiformis], and it will be noticed that its inner or apical part is of a distinctly paler colour than the outer; hence this inner part is known as the *globus pallidus*, while the outer or basal part is the *putamen* or husk. The globus pallidus often shows a division into outer and inner parts.

The three sides of the lenticular nucleus are bounded by white matter which forms its capsule. Anteriorly and

FIG. 148.—HORIZONTAL SECTION OF THE CEREBRUM TO SHOW THE BASAL GANGLIA. (FROM A PHOTOGRAPH.)

G.C.C. Genu of Corpus Callosum. *For.Mi.* Forceps Minor. *A.H.* Anterior Horn of Lateral Ventricle. *C.N.* Caudate Nucleus (head). *A.P.For.* Anterior Pillars of Fornix. *F.M.* Foramen of Monro. *Put.* Putamen. *G.Pal.* Globus Pallidus. *3rd V.* Third Ventricle. *I.Cap.* Internal Capsule. *Op.Th.* Optic Thalamus. *C.N²*. Caudate Nucleus (tail). *I. of R.* Island of Reil. *Cl.* Claustrum. *P.P.For.* Posterior Pillar of Fornix. *D.H.* Descending Horn of Lateral Ventricle. *For.Ma.* Forceps Major. *O.Rad.* Optic Radiations. *Calc.F.* Calcarine Fissure with White Line of Gennari. *I.P.Oc.F.* Internal Parieto-occipital Fissure. *Cun.* Cuneus.

posteriorly are the two limbs of the internal capsule, while on the outer side the external capsule lies.

The *internal capsule* is a most important region, since through it run the nerve paths which connect the motor and sensory areas on the surface of the brain with the crura cerebri, medulla and spinal cord.

The two limbs join at an angle opposite the apex of the lenticular nucleus, forming the *genu*, while of the two the anterior is only about half the length of the posterior. It will be noticed that the anterior limb separates the lenticular from the caudate nucleus, while the posterior separates the lenticular nucleus from the optic thalamus.

In the substance of the internal capsule some of the ganglionic end arteries which enter the anterior perforated space are cut; the "artery of cerebral hæmorrhage," referred to on p. 318, is said to supply the region just behind the genu in which the motor fibres from the precentral convolution are gathered in one bundle, so that hæmorrhage from or occlusion of this artery, when it occurs, would produce paralysis of the opposite side of the body.

Outside the lenticular nucleus and bounding its base is the narrow strip of white matter known as the *external capsule,* of much less physiological importance than the internal. It separates the lenticular nucleus from the *claustrum,* a narrow streak of grey matter which forms the third nucleus of the corpus striatum, the other two being, of course, the caudate and lenticular nuclei. Outside it is another layer of white matter, and then the grey matter of the gyri of the insula. It will be noticed that the claustrum corresponds almost exactly to the extent of the insula.

Other things to be looked for in this section are—

1. The bundle of Vicq d'Azyr, a small circular patch embedded in the optic thalamus, a little distance behind the anterior pillar of the fornix.

2. The *Optic Radiation* [radiationes occipito-thalamicæ],

a very dead-white tract lying on the outer side of the posterior horn of the lateral ventricle, and running from the lower visual centres (superior quadrigeminal body, geniculate bodies and pulvinar) to the higher visual centre or grey matter in the neighbourhood of the calcarine fissure (Fig. 148).

3. The *white band of Gennari*—a white stripe in the grey matter of the occipital cortex, best marked in the immediate neighbourhood of the calcarine fissure, but reaching as far as the occipital pole and even on to a little of the outer surface of the occipital lobe. Its presence marks the visual area of the cortex (see Fig. 148).

On the opposite side of the brain make a section obliquely downwards and backwards, passing through the front of the optic thalamus and the crusta of the crus cerebri. This will pass through the internal capsule a little behind its genu, and display the course of the *motor tract* from the capsule into the crus cerebri. As the upper part of the brain has been cut away, the upper part of the tract where it leaves the region of the Rolandic fissure cannot be seen, but it is clear that its fibres must converge a good deal as the capsule is approached. This convergence is known as the *corona radiata.*

It is also clear that the fibres of the corona radiata could not reach the internal capsule from the cerebral cortex without decussating with the tapetal fibres of the corpus callosum. This decussation occurs in and largely forms the centrum ovale majus.

In order to display the course of the *sensory tract* a section should be made parallel to and a little behind the last. This would probably pass through the red nucleus in its lower part (see p. 293), immediately to the outer side of which the *fillet* [lemniscus] lies on its way up from the medulla to the optic thalamus. Above this the posterior limb of the internal capsule will be cut, in which are fibres running up from the thalamus to the cortex.

As one-half of the first brain, on which the convolutions

were studied, has been left undissected, a series of transverse vertical or coronal sections may be made in it, although they are not as satisfactory as they would be if a complete third brain could be devoted to their study.

The accompanying five photographs of sections taken at definite points will enable the dissector to recognise most of the structures he comes across in his own sections, which may, of course, be much more numerous.

If a complete brain can be devoted to this purpose it should be laid on a dish which has been turned upside down, the base should be upward and the convex upper surface should be well padded up with tow. The longest knife obtainable should be used to make the sections, which should be done with clean, sweeping cuts.

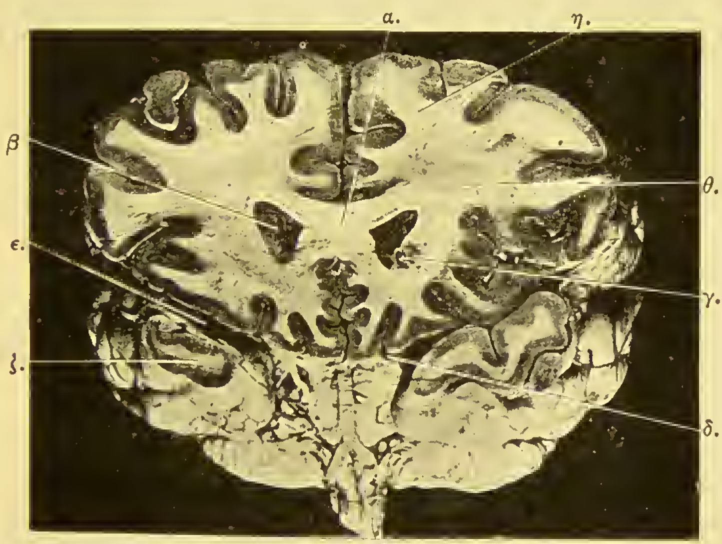


FIG. 149.—SECTION THROUGH THE TIP OF THE TEMPORAL LOBE.

α. Genu of corpus callosum.
β. Anterior horn of lateral ventricle.
γ. Most anterior part of caudate nucleus.
δ. Olfactory tract lying in the mouth of the sulcus rectus.
ε. Vallecula Sylvii.
ζ. Temporal pole cut through.
η. Centrum ovale minus.
θ. ,, ,, majus.

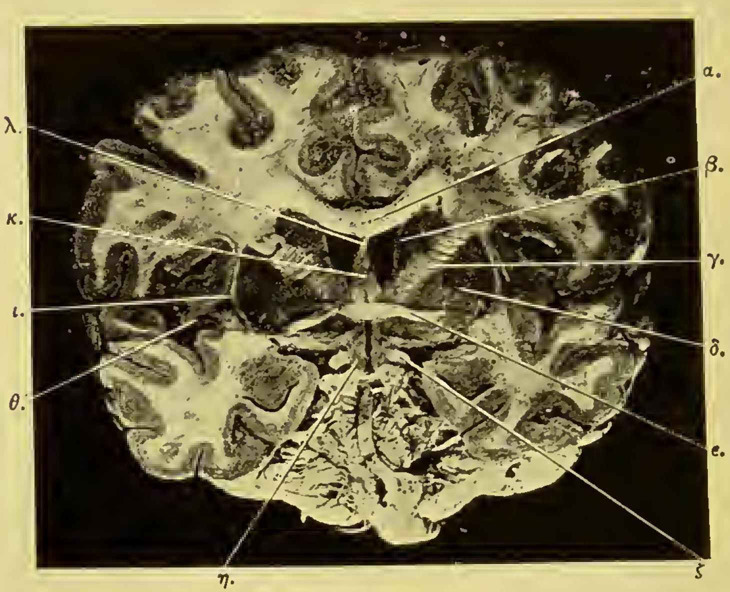


FIG. 150.—SECTION THROUGH THE TUBER CINEREUM A LITTLE BEHIND THE OPTIC COMMISSURE.

α. Corpus callosum.
β. Caudate nucleus.
γ. Internal capsule.
δ. Lenticular nucleus.
ε. Anterior commissure.
ζ. Optic tract.
η. Tuber cinereum.
θ. Insula.
ι. Claustrum.
κ. Anterior pillar of fornix.
λ. Septum lucidum.

The line leading from ζ on the right side of the diagram passes through the apex of the wedge shaped amygdaloid nucleus.

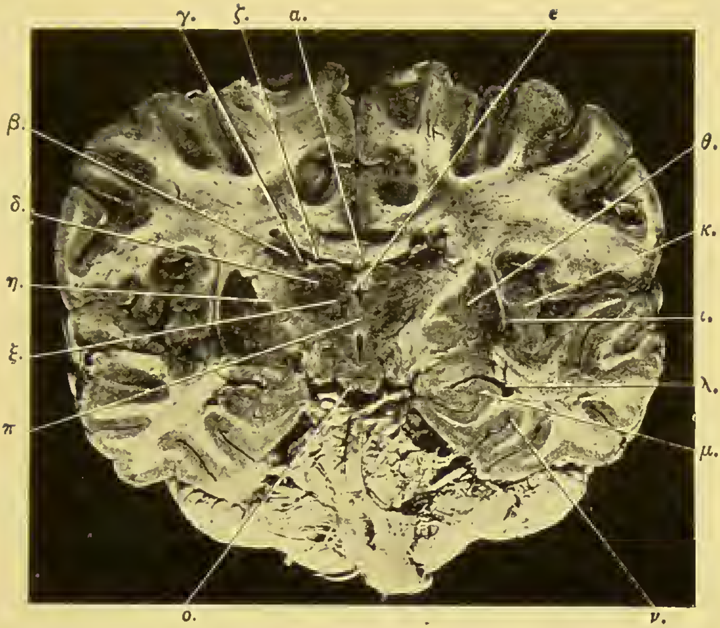


FIG. 151.—SECTION THROUGH THE CORPORA ALBICANTIA.

- *a*. Corpus callosum.
- *β*. Caudate nucleus.
- *γ*. Vein of the corpus striatum with tænia semicircularis close to it.
- *δ*. Optic Thalamus.
- *ε*. Fornix.
- *ζ*. Cavity of Lateral Ventricle.
- *η*. Internal Capsule.
- *θ*. Lenticular Nucleus.
- *ι*. Claustrum.
- *κ*. Insula.
- *λ*. Descending horn of lateral ventricle.
- *μ*. Hippocampus major with hippocampal fissure in its interior.
- *ν*. Collateral fissure.
- *ξ*. Bundle of Vicq d'Azyr.
- *o*. Corpus albicans.
- *π*. Middle commissure.

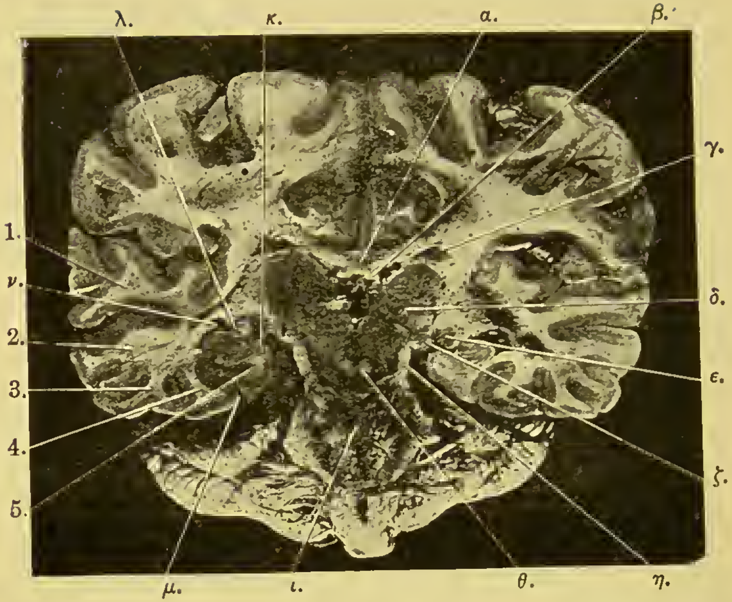


FIG. 152.—SECTION THROUGH THE MIDDLE PART OF THE PONS VAROLII.

α. Corpus callosum.
β. Fornix.
γ. Caudate nucleus.
δ. Optic Thalamus.
ε. External geniculate body.
ζ. Internal geniculate body.
η. Fillet.
θ. Red nucleus.
ι. Section of Pons.
κ. Hippocampal gyrus.
λ. Fimbria and Choroid fissure.
μ. Collateral fissure.
ν. Tail of caudate nucleus.

The numbers 1 to 5 indicate the five temporal convolutions referred to on p. 313.

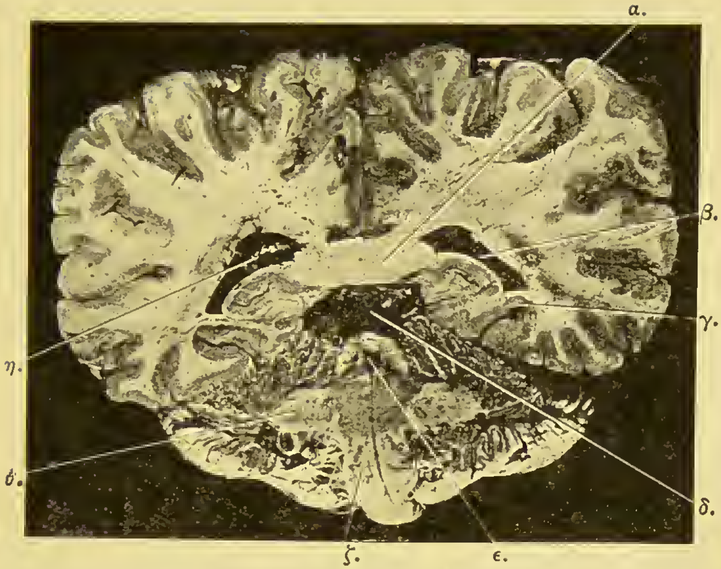


FIG. 153.—SECTION THROUGH THE HIND END OF THE CORPUS CALLOSUM.

α Splenium of Corpus callosum.
β. Descending horn of lateral ventricle sinking down from the body of the ventricle.
γ. Collateral eminence formed by collateral fissure.
δ. Cisterna venæ magnæ cerebri.
ε. Fourth ventricle.
ζ. Olivary nucleus in medulla.
η. Choroid plexus.
θ. Middle cerebellar peduncle.

THE LOWER EXTREMITY

As soon as the body comes into the room the dissector should carefully wrap the lower extremity in some air-tight material, such as oiled linen or india-rubber tissue, and bandage this on tightly.

During the first seven days, while the body is on its face, the gluteal region, popliteal space, and as much as possible of the back of the thigh should be dissected.

DISSECTION OF THE GLUTEAL REGION OR BUTTOCK

The Buttock is the protuberant region seen posteriorly at the junction of the thigh and trunk. Its prominence is partly due to muscle, partly to fat. Note that the buttocks are separated from each other by the deep *natal cleft* in which lies the anus. The sides of the cleft are covered with a variable amount of hair. The buttock is sharply limited below by a crescentic crease—the *fold of the nates*, the concavity of which looks upward. On all other sides the buttock fades without any definite line of demarcation into surrounding parts. The skin of the buttock is thick and coarse.

Before reflecting the skin the student should determine the position of various bony prominences. The *crest of the ilium* separates the buttock from the flank; trace it forwards by pressure with the finger to the anterior superior iliac spine, and backwards to the posterior superior iliac spine; the position of the latter point is often more obvious to the eye than to the finger, lying as it does immediately

beneath a dimple at the level of the second sacral spine. Close to the inner end of the natal crease the rounded prominence of the *ischial tuberosity* can be felt, but the pressure must be made from below and not through the mass of the gluteus maximus muscle. A straight line from this tuberosity to the anterior superior iliac spine passes about midway immediately above the *great trochanter of the femur*, the position of which is further indicated by a shallow depression on the surface.

Reflexion of Skin.—Make an incision, if it has not already been made by the dissector of the abdomen, along the iliac crest from the anterior to the posterior spine, and continue it downwards and backwards to the tip of the coccyx, from which point the incision should run downwards and outwards to the outer border of the thigh midway between the great trochanter and the knee. The skin enclosed by these incisions should now be reflected outwards.

The underlying fascia is loaded with fat, and in consequence the numerous small cutaneous nerves are not readily found unless the student knows exactly where to look. Let a finger be passed along the iliac crest until a distinct thickening is felt two inches or so behind the anterior superior iliac spine, a thickening known as the *tubercle of the crest.* Make an incision downwards and slightly outwards, through the superficial fascia, from this tubercle, when in all probability a few nerve filaments will be found which, if traced upwards, will lead to a relatively large nerve which pierces the deep fascia just above the tubercle on the iliac crest; it is the *iliac branch of the ilio-hypogastric nerve* [ramus cutaneus lateralis nervi ilio-hypogastrici]. Another incision parallel with the last, but an inch anterior, should be made exposing the *lateral cutaneous or iliac branch of the last thoracic nerve* (see Fig. 154).

An incision should next be carried vertically downwards from the iliac crest, beginning where the outer border of the erector spinæ muscle can be felt, three inches or so from the

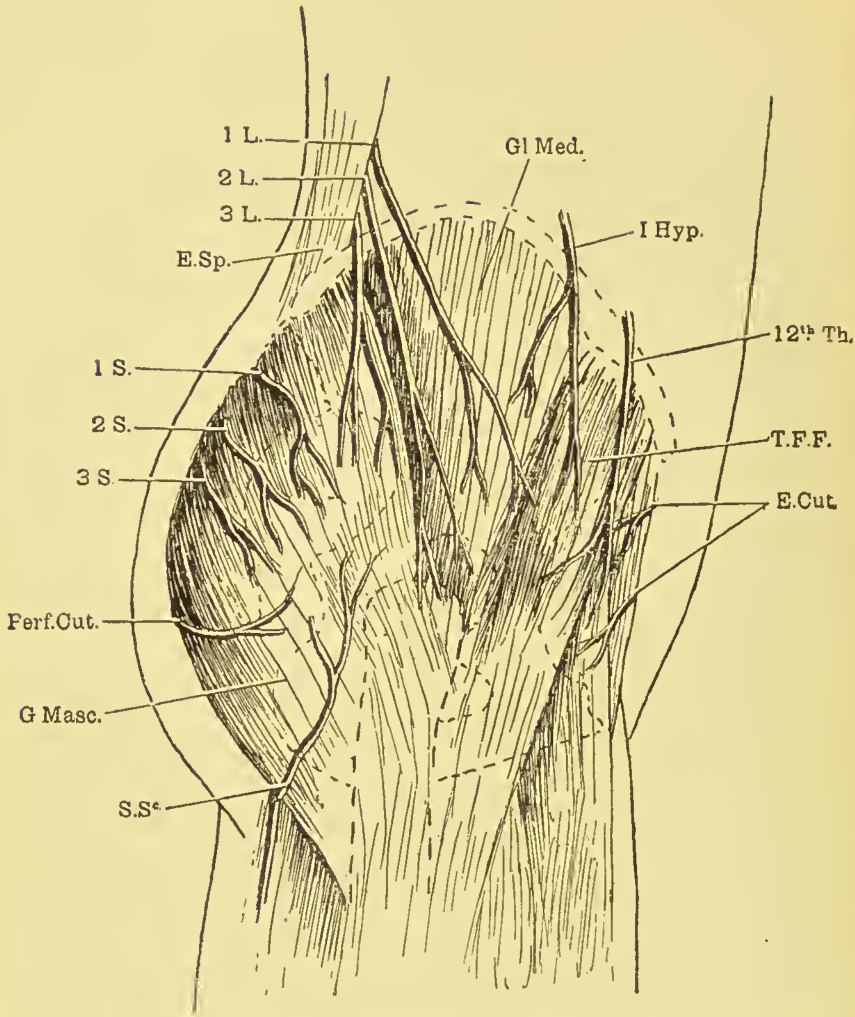


FIG. 154.—SCHEME OF THE SUPERFICIAL NERVES OF THE GLUTEAL REGION.

1, 2, 3 *L.* Posterior Primary Divisions of the Upper three Lumbar Nerves. 1, 2, 3 *S.* Posterior Primary Divisions of the Upper three Sacral Nerves. *E.Sp.* Erector Spinæ. *Perf.Cut.* Perforating Cutaneous Nerve. *G.Masc.* Gluteus Maximus. *S.S^c.* Gluteal Cutaneous of Small Sciatic Nerve. *E.Cut.* External Cutaneous Twigs. *T.F.F.* Tensor Fasciæ Femoris. 12th *Th.* Lateral Cutaneous Branch of Last Thoracic Nerve. *I.Hyp.* Iliac Branch of Ilio-hypogastric Nerve crossing the Crest at the Tubercle. *Gl.Med.* Gluteus Medius.

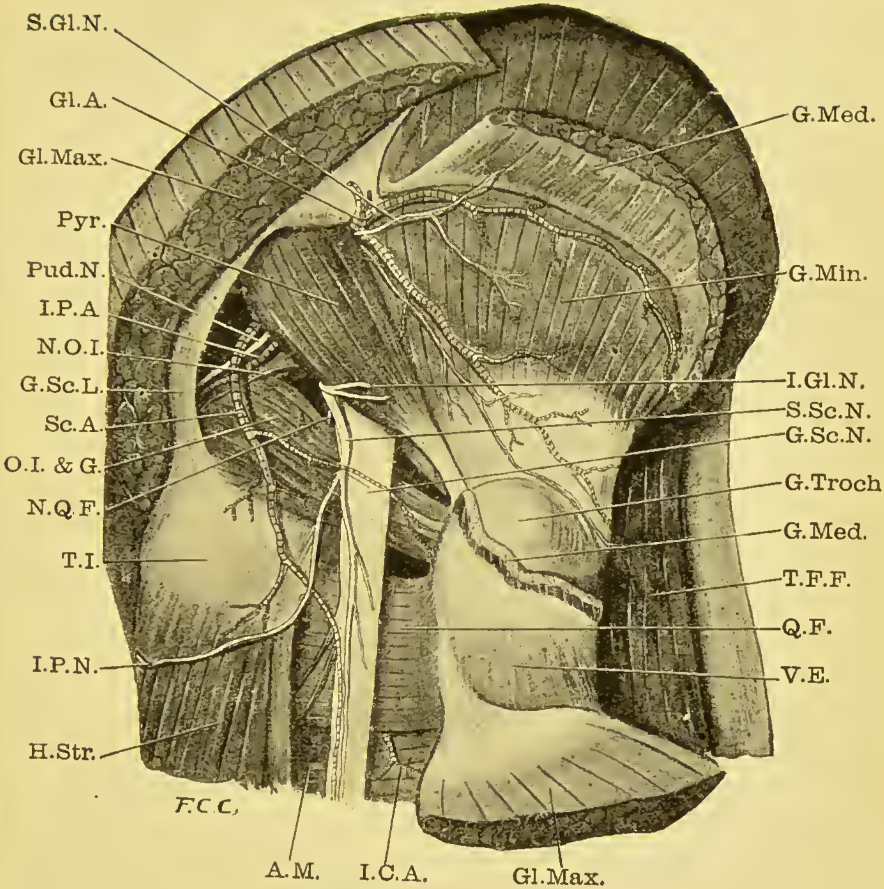


FIG. 155.—DISSECTION OF THE RIGHT GLUTEAL REGION.

G.Med. Gluteus Medius. *G.Min.* Gluteus Minimus. *I.Gl.N.* Inferior Gluteal Nerve. *S.Sc.N.* Small Sciatic Nerve. *G.Sc.N.* Great Sciatic Nerve. *G.Troch.* Great Trochanter. *T.F.F.* Tensor Fasciæ Femoris. *Q.F.* Quadratus Femoris. *V.E.* Vastus Externus. *I.C.A.* Internal Circumflex Artery (Transverse Branch). *A.M.* Adductor Magnus. *H.Str.* Hamstrings. *I.P.N.* Inferior Pudendal Nerve. *T.I.* Tuber Ischii. *N.Q.F.* Nerve to Quadratus Femoris. *O.I.* and *G.* Obturator Internus and Gemelli. *Sc.A.* Sciatic Artery. *G.Sc.L.* Great Sacro-sciatic Ligament. *N.O.I.* Nerve to the Obturator Internus. *I.P.A.* Internal Pudic Artery. *Pud.N.* Pudic Nerve. *Pyr.* Pyriformis. *Gl.A.* Gluteal Artery. *S.Gl.N.* Superior Gluteal Nerve.

middle line. In the line of this incision a number of nerves will be found lying close together in the form of a leash; they are derived from the *external branches of the posterior primary divisions of the upper three lumbar nerves* (Fig. 154).

Along a line from the posterior superior iliac spine to the tip of the coccyx five small nerves should be looked for. The upper three are the largest and are to be found at intervals of an inch; they are from the *external branches of the posterior primary divisions of the upper three sacral nerves.* The easiest way to find these nerves is to cut through the superficial fascia in the posterior median line and to turn it carefully outwards, keeping a sharp look-out for any fine nerve filaments piercing the deep fascia to enter it.

The lower two are extremely minute, and are from the posterior and anterior sacro-coccygeal plexuses in descending order. Winding round the lower border of the gluteus maximus, internal to the tuber ischii and passing upwards on to the buttock, are a few small and inconstant twigs from the *perforating cutaneous nerve,* which comes, as a rule, from the anterior primary divisions of the second and third sacral nerves, while passing in the same direction but external to the tuber ischii are larger nerves—the *gluteal cutaneous branches of the small sciatic* (see Fig. 154).

Turning now to the outer limit of the buttock, the student may find below the great trochanter a few branches passing obliquely downwards and backwards from the *posterior division of the external cutaneous nerve.*

The cutaneous nerves of the buttock are thus seen to be numerous and to be derived from various sources, from both the anterior and posterior primary divisions of the spinal nerves as high up as the last thoracic and as low as the coccygeal.

Accompanying the various nerves are small vessels, the unnamed branches and tributaries of adjoining trunks; the most constant are those accompanying the branches from the upper three sacral nerves—they are from the sciatic vessels.

Thc superfieial faseia should be now removed, the nerves being turned baek as they are met, and the *gluteus maximus* [m. glutæus maximus] eleaned. It is convenient to remove all the faseia together and at the same time, and by the same process, to clean the musele. To do this make an ineision parallel with and just above the upper border of the gluteus maximus. The incision should be carried right down to the strong fibrous gluteal aponeurosis. Then refleet the faseiæ by bold sweeps of the scalpel, always cutting parallel to the museular fibres, and see that all the borders and eorners of the musele are cleaned. Great eare should be exereised along the lower border, where the *small sciatic nerve* [n. eutaneus femoris posterior] in particular is in danger. It is not a bad plan to disseet out this nerve before the reflexion is completed. It passes vertieally down the baek of the thigh about midway between the great trochanter and the tuber isehii. The small reeurrent twigs to the skin of the buttoek [nn. elunium inferiores] are useful guides to the main trunk.

The gluteus maximus musele will thus be seen to arise from the baek part of the dorsum ilii above the superior eurved line, from the adjaeent portion of the iliae erest, the lumbar faseia, the side of the lower part of the saerum and upper part of the eoccyx. The musele should now be earefully separated from its origin. In doing this it is better to start from below and keep elose to the origin, shaving the musele quite away, as an overhanging edge of it interferes with the later disseetion.

A strong ligament, the *great sacro-sciatic* [lig. sacro-tuberosum], will be seen passing between the saerum and ilium to the isehium. A large number of the deep fibres of the gluteus maximus arise from the superfieial surfaee of this ligament. From these extensive origins the fibres of the gluteus maximus pass downwards and outwards. The superfieial fibres of the musele and the upper deep fibres are inserted into a strong fibrous band whieh passes down from

the iliac crest to the outer tuberosity of the tibia—the *ilio-tibial band.* The lower deep fibres are inserted into the gluteal ridge on the femur, as will be seen later. The gradual separation of the muscle from its origin, and its complete reflexion outwards, necessitate the division of certain vessels and nerves which enter the deep surface of the muscle; they are the superficial branches or tributaries of the *gluteal vessels* and the *inferior gluteal nerve.* Before these structures are divided, however, they should be scrupulously cleaned, and it is often convenient to cut out and leave small balls of muscle around the terminations of the inferior gluteal nerve, so that the nerve, when thrown back, may not be mistaken for the small sciatic. At this stage the insertion of the lower deep fibres into the gluteal ridge of the femur should be exposed.

By the reflexion of the gluteus maximus a large number of structures of great variety comes into view. The *bursæ* [B. glutæo-femorales] should be first examined, as they tend to dry up. Of these there are three—one over the tuber ischii, one over the lower part of the great trochanter, and one between the fibres of the muscle going to the ilio-tibial band and the vastus externus muscle. In order to expose this last bursa, incise the upper border of the tendon of insertion of the muscle and push the finger down between the two laminæ. The finger will enter a large space, and on looking in the glistening aponeurosis of the vastus externus muscle can be seen. The other two bursæ should be pinched up, their walls incised, and their cavity explored. They are frequently multilocular, but in old people it is not unusual to find that the bursa superficial to the tuber ischii has been converted into fibrous tissue.

After the bursæ have been examined, feel by deep pressure for the boundaries of the *great and small sacro-sciatic foramina.* In identifying these, much help will be obtained by making reference to a pelvis or skeleton. Note, further, that between the two foramina the *ischial spine* can be felt.

The great sacro-sciatic foramen will be seen to be divided into an upper and lower part by the *pyriformis muscle*, which, arising inside the pelvis from the front of the sacrum, passes through the foramen and crosses the buttock in an outward and slightly downward direction, to be inserted into the upper border of the great trochanter, where it is in close relation to the insertion of the obturator internus.

At the upper border of the pyriformis, the *gluteal artery* [a. glutæa superior] will be found coming into the buttock through the upper part of the great sacro-sciatic foramen. The branches of its superficial division have been already met entering the deep surface of the gluteus maximus. The deep division will be seen passing outwards deep to the gluteus medius; with it lies the *superior gluteal nerve.* They should at present be merely recognised, and no attempt made to follow them to their destination (see Fig. 155).

At the lower border of the pyriformis two arteries and six nerves appear. Running almost vertically down between the tuber ischii and the great trochanter are the sciatic artery and the small sciatic nerve, the great sciatic nerve, and the nerve to the quadratus femoris. Running backwards to enter the deep surface of the gluteus maximus is the inferior gluteal nerve, while running a curved course round the ischial spine are the nerve to the obturator internus, the internal pudic vessels, and pudic nerve.

Begin by cleaning up the *inferior gluteal nerve,* which has been met already and divided in reflecting the gluteus maximus. With some of its lower branches will be found branches of the sciatic artery, which should be followed to the main trunk appearing at the lower border of the pyriformis. The next structure to be identified is the *small sciatic nerve* [n. femoris posterior], the most superficial of the three nerves which pass vertically down into the thigh. In cleaning this nerve care should be taken to save a large branch which passes almost directly inwards about an inch below the tuber ischii and round the tendons of the ham-

string muscles arising therefrom; the branch is called the *inferior pudendal nerve* [ramus perinealis nervi femoris posterioris]. Next clean the *great sciatic nerve* [n. ischiadicus], which is readily recognised by its size and by its lying immediately deep to the small sciatic nerve.

Occasionally the great sciatic nerve is represented by two nerve trunks, the internal and external popliteal divisions; the former of which is the deeper and may be traced to the lower border of the pyriformis, while the latter, more superficial, can often be seen piercing the muscle. Even when the two divisions are not thus separated, it is quite easy, by opening its sheath, to show that the nerve is formed by the juxtaposition of two distinct nerve trunks. If now the great sciatic nerve, just as it enters the buttock, be pulled aside, the lower margin of the great sacro-sciatic notch will be exposed, and, lying upon it, there will be seen the *nerve to the quadratus femoris muscle.* Next feel for the ischial spine and the small sacro-sciatic ligament [lig. sacro-spinosum] attached to its apex. Resting upon these structures, from the base of the spine inwards, are the *nerve to the obturator internus*, the *internal pudic artery* [a. pudenda interna], with a vein on either side, and the *pudic nerve* [n. pudendus], all of which should be picked up with the forceps and cleaned in that portion of their course which lies in the buttock.

These various structures having been identified and carefully dissected out, attention should next be directed to the underlying muscles. Begin by cleaning the *pyriformis*, taking great care not to damage the structures at its upper and lower borders. It will be found to pass from its origin in the pelvis, through the great sacro-sciatic foramen, into the buttock to its insertion into the upper border of the great trochanter under cover of the gluteus medius.

Above the pyriformis lies the large *gluteus medius*, which arises not only from a large area on the underlying dorsum ilii, between the superior and middle-curved lines, but also

from a dense superficial aponeurosis known as the *gluteal fascia,* a part of the fascia lata of the thigh. The muscle can only be separated from this fascia by cutting through the muscular fibres of origin. The muscle is inserted into the diagonal line which runs downwards and forwards on the outer surface of the great trochanter. Clean the surface and borders of the muscle as well as possible, and note that the posterior fibres are inserted highest on the ridge (Fig. 155).

Below the pyriformis will be found the tendon of the *obturator internus muscle* with the small *superior* and *inferior gemelli muscles* along its upper and lower borders. The three structures, traced outwards, end in a common tendon which is inserted into the great trochanter immediately in front of the tendon of the pyriformis. Traced inwards the obturator internus tendon can be seen to pass into the pelvis through the small sacro-sciatic foramen, whereas the superior and inferior gemelli stop at the ischial spine and ischial tuberosity respectively from which they take their origin. It is not infrequent to find the muscular fibres of the gemelli conjoined with each other and with the tendon of the obturator internus from their origin to their insertion. In such a case it may be necessary to cut through the fibres of the gemelli before the obturator tendon is exposed. In cleaning up these muscles the nerves supplying them should be dissected out, if this has not already been done. The nerve to the obturator internus gives off the nerve to the superior gemellus, while the nerve to the quadratus femoris has a common origin with that for the inferior gemellus.

Below the inferior gemellus lies the *Quadratus Femoris,* a muscle measuring a little over an inch from its superior to its inferior border. Its fibres are parallel and run horizontally from the outer border of the tuber ischii to the back of the femur below the mid point of the intertrochanteric line. Its nerve, already noted, enters the muscle on its deep aspect after passing deep to the obturator internus and gemelli. Below the quadratus femoris lies the *Adductor*

Magnus muscle, easily distinguished from the straight lower margin of the quadratus femoris by its crescentic upper border. The adductor magnus is not an easy muscle to understand, and it should be studied therefore from all points of view. Note that the fibres forming the upper border are coming from the pubis, while those arising from the ischial tuberosity are passing almost vertically downward.

Rising from the posterior surface of the tuber ischii are the three hamstrings. Of these the *biceps* and *semitendinosus* are superficial and the *semimembranosus* deep. Notice that the biceps is tendinous and external at its origin, while the semitendinosus, in spite of its name, is fleshy and internal. The semimembranosus rises by a flat tendon which lies deep to the other two and appears slightly on their outer side.

Having cleaned the various muscles the dissector should next trace the vessels and nerves already identified in both proximal and distal directions. The dissection may be rendered more easy by removing the venæ comites, the course of which in the buttock is identical with that of the arteries. Special care should be given to the structures—viz. the nerve to the obturator internus, the internal pudic vessels and pudic nerve—lying on the ischial spine and small sacro-sciatic ligament. The branch from the first named to the superior gemellus should be looked for.

At the upper border of the quadratus femoris the small *ascending branch of the internal circumflex artery* is often to be observed, while deep in the interval between this muscle and the inferior gemellus lies the tendon of the obturator externus muscle.

At the lower border of the quadratus femoris another branch, the *transverse*, of the *internal circumflex artery* should be looked for; it anastomoses with the transverse branch of the external circumflex, the two vessels forming a more or less complete arterial ring round the shaft of

the femur, immediately below the small trochanter. If the quadratus femoris be cut through and reflected, this latter bony prominence will be easily recognised with the tendon of the ilio-psoas inserted into it. Note that the trochanter points backwards as well as inwards.

At a still lower level an artery of considerable size, *the first perforating artery,* will be seen appearing through the fibres of the adductor magnus muscle and lying directly upon the femur. On reaching that portion of the gluteus maximus which is inserted into the gluteal ridge the artery divides into two branches, one of which passes onwards through the muscle, while the other passes more or less vertically upwards under cover of the gluteus maximus as originally placed. Certain arteries of the buttock—viz. the gluteal, sciatic, internal circumflex and first perforating freely anastomose under cover of the gluteus maximus. This anastomosis is of considerable importance in effecting the collateral circulation rendered necessary after ligation of the external iliac or the femoral arteries.

The gluteus medius should now be reflected by detaching it from the dorsum ilii. This is best effected by making a curved incision with its convexity upwards through the substance of the muscle just below its upper limit, then pass the handle of the scalpel between the muscle and the bone and so separate the muscle from its area of origin. The procedure should be executed with care in order that the underlying structures may not be harmed. Its nerve of supply comes from the superior gluteal nerve and enters it on its deep surface close to its posterior border.

The *Gluteus Medius* [m. glutæus medius] arises from the dorsum ilii between the iliac crest and superior curved line above and the middle curved line below, also from the strong fascia which lies over that portion of the muscle which is uncovered by the gluteus maximus. Its fibres converge towards its tendon of insertion, which is attached to the diagonal ridge on the external surface of the great trochanter, separat-

ing an area above for a bursa deep to the gluteus medius from an area below for a bursa deep to the gluteus maximus.

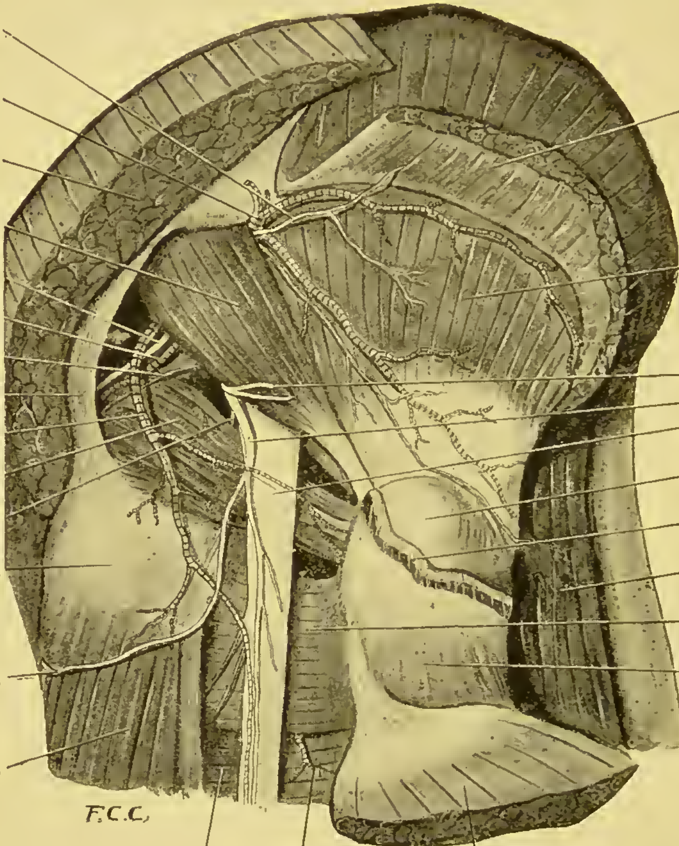


FIG. 156.—DISSECTION OF THE RIGHT GLUTEAL REGION.

G.Med. Gluteus Medius. *G.Min.* Gluteus Minimus. *I.Gl.N.* Inferior Gluteal Nerve. *S.Sc.N.* Small Sciatic Nerve. *G.Sc.N.* Great Sciatic Nerve. *G.Troch.* Great Trochanter. *T.F.F.* Tensor Fasciæ Femoris. *Q.F.* Quadratus Femoris. *V.E.* Vastus Externus. *I.C.A.* Internal Circumflex Artery (Transverse Branch). *A.M.* Adductor Magnus. *H.Str.* Hamstrings. *I.P.N.* Inferior Pudendal Nerve. *T.I.* Tuber Ischii. *N.Q.F.* Nerve to Quadratus Femoris. *O.I.* and *G.* Obturator Internus and Gemelli. *Sc.A.* Sciatic Artery. *G.Sc.L.* Great Sacro-sciatic Ligament. *N.O.I.* Nerve to the Obturator Internus. *I.P.A.* Internal Pudic Artery. *Pud.N.* Pudic Nerve. *Pyr.* Pyriformis. *Gl.A.* Gluteal Artery. *S.Gl.N.* Superior Gluteal Nerve.

When it is noticed how directly above the great trochanter the origin of the gluteus medius is, it will easily be appreciated that this muscle must act as a powerful abductor of the hip. It should be remembered, however, in thinking out the actions of any of the lower extremity muscles, that when the foot is on the ground the lower attachment acts as the origin. Doubtless, the usual action of this muscle is to lateralise the pelvis in walking, thus bringing the centre of gravity of the body directly over the hip-joint and allowing the other foot to be lifted off the ground.

On turning the muscle downward the bursa above mentioned, between it and the great trochanter, should be looked for. A considerable portion of the dorsum ilii is now exposed as well as the gluteus minimus, which hitherto has been completely hidden by the medius. The deep division of the gluteal artery and the superior gluteal nerve are now exposed, and should be carefully cleaned. In particular the anterior fibres of the gluteus minimus should be closely scrutinised, for passing forward between them is a small branch of the superior gluteal nerve which enters the tensor fasciæ femoris muscle on its deep surface.

The *deep division of the Gluteal artery* divides into an upper and a lower branch, and ends in anastomoses along the anterior border of the ilium (Fig. 156).

The *Gluteus Minimus* [m. glutæus minimus] arises from the dorsum ilii between the middle curved line above and the inferior curved line below. Its fibres converge to the tendon of insertion, which passes over the great trochanter, a bursa intervening, and gains attachment to the anterior surface of that process.

It should be divided in a manner similar to that in which the gluteus medius was treated. On turning it down the aforementioned bursa should be looked for. By the reflexion of the muscle the *capsule of the hip-joint* will be exposed. This should be carefully cleaned, when it will be noticed that

its upper portion is, from the posterior aspect, much thicker than the lower portion, a condition to some extent attributable to the fact that with the upper portion is blended the so-called reflected head of the rectus femoris muscle, the head passing forwards from its origin immediately above the acetabulum to join at a right angle the straight head which descends from the anterior inferior iliac spine. The lower portion of the capsule posteriorly should be closely observed, for, with the exception of a small portion anteriorly where the capsule is not infrequently absent, allowing the synovial membrane to protrude as a bursa under the ilio-psoas, it is the weakest portion of the capsule, and is the part which is almost invariably rent by the head of the femur in dislocation of the hip. Further, it is on the posterior aspect of the capsule that the circular fibres, the so-called *zonular band,* are most evident. Attached to the body of the ischium just below and behind the acetabulum, they pass forward as a distinct band to be finally lost among the other fibres of the capsule. If the nerve to the quadratus femoris be again examined, it may be now possible to trace a branch from it to the capsule of the joint.

In exposing the joint the *tensor fasciæ femoris* will be seen. It rises from the anterior two inches of the iliac crest, and is inserted into the ilio-tibial band.

Before leaving the gluteal region it will be well to take special notice of three points concerning which mistakes are often made in the examination room. The first is that the origin of the semi-membranosus must be sought deep to that of the other two hamstrings.

The second is that the shiny aponeurosis on the outer side of the thigh, exposed when the gluteus maximus is reflected, is the origin of the vastus externus and not the ilio-tibial band.

The third point is that the adductor magnus appears in the gluteal region on both sides of the hamstrings.

THE POPLITEAL SPACE

After the dissection of the buttock, it is convenient to pass to the study of the popliteal space, the boundaries of which are kept in position by the unreflected skin of the back of the thigh above and of the back of the calf below. The space is in reality an inter-muscular cleft between the hamstring muscles above and the calf muscles below. It is occupied by the popliteal vessels and nerves, surrounded by a considerable amount of fatty areolar tissue, in which a few lymphatic nodes may be found.

Superficial Anatomy

Before reflecting the skin of the region note that in the undissected state the surface is slightly convex so long as the knee is extended, whereas in the dissected state the space will be found to be deeply cupped. A well-marked transverse crease should also be noticed; it is situated some distance above the line of the knee-joint. On either side of the space the hamstring tendons can be readily felt—on the outside the tendon of the biceps, on the inside the tendon of the semi-tendinosus superficial, and that of the semi-membranosus deep. These tendons can be most readily felt in one's own leg, and can be rendered very distinct by flexing the knee. Immediately to the inner side of the tendon of the biceps, and close to the head of the fibula, the external popliteal nerve can be rolled between the finger and the underlying bone.

Dissection.—Make a median incision through the skin covering the space beginning and ending a hand's-breadth above and below the level of the knee-joint. At the extermities of this incision make transverse incisions from the inner to the outer border of the limb. Reflect the skin carefully inward and outward. In the upper half of the space a

few small twigs should be looked for in the superfieial fascia near the middle line; they are derived from the *small sciatic nerve.* In the lower half of the spaee the small sciatic nerve itself will be found in the superficial faseia near the middle line, having pierced the deep fascia immediately below the line of the knee-joint. The *External Saphenous Vein* [v. saphena parva], whieh lies in the same region, will often serve as a useful guide to the nerve. At or near the spot where the small sciatic nerve pierces the deep fascia to become subcutaneous, the external saphenous vein, ceasing to be subcutaneous, sinks through the deep fascia to join the popliteal vein.

In many cases, however, the vein does not end as here described, but is traceable for a variable distance in the superficial fascia of the back of the thigh. A few small arterial twigs will be seen piercing the deep faseia and ramifying in the superficial faseia covering the space.

Remove the superficial fascia while retaining the vessels and nerves, thereby exposing the dense popliteal fascia, the fibres of whieh run in different directions but on the whole transversely. It is this fascia whieh keeps the boundaries of the space together, and whieh aceounts for the convexity of the surface in the undisseeted state.

Cut through the popliteal fascia in the median line of the limb and turn it aside, thereby exposing the fatty areolar tissue in which the vessels and nerves lie.

Lying elose to the inner side of the tendon of the biceps is the *External Popliteal nerve* [n. peronæus communis], which should first be found. To the inner side of this, lying almost in the mid line of the limb, the *Internal Popliteal nerve* [n. tibialis] should next be identified. Now clean the two popliteal nerves from above downward, taking every precaution not to cut their branches. It is not a bad plan to place a pair of foreeps under the upper part of the nerve, thereby raising it and making its branches more evident. Any small arteries met in the dissection should be

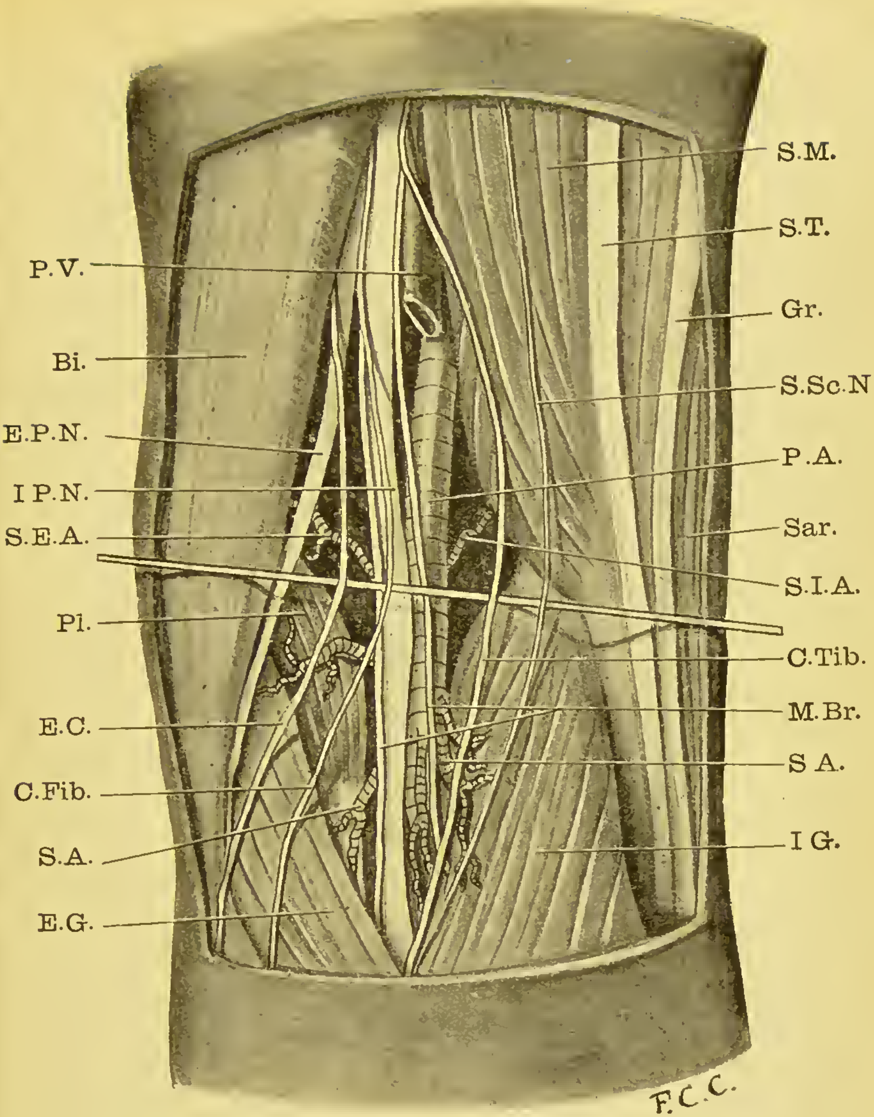


FIG. 157.—DISSECTION OF THE LEFT POPLITEAL SPACE.

P.V. Popliteal Vein. *Bi.* Biceps. *E.P.N.* External Popliteal Nerve. *I.P.N.* Internal Popliteal Nerve. *S.E.A.* Superior External Articular Artery. *Pl.* Plantaris. *E.C.* Cutaneous Branches of External Popliteal Nerve. *C.Fib.* Communicans Fibularis Nerve. *S.A.* Sural Artery. *E.G.* Outer Head of Gastrocnemius. *S.M.* Semi-membranosus. *S.T.* Semi-tendinosus. *Gr.* Gracilis. *S.Sc.N.* Small Sciatic Nerve. *P.A.* Popliteal Artery. *Sar.* Sartorius. *S.I.A.* Superior Internal Articular Artery. *C.Tib.* Communicans Tibialis Nerve. *M.Br.* Muscular Branches of Internal Popliteal Nerve. *I.G.* Internal Head of Gastrocnemius.

cleaned and preserved; the smaller veins may be cut and removed.

The external popliteal nerve lies in its whole course within the space along the inner border of the biceps. It leaves the space by winding round the neck of the fibula, lying directly on the bone, covered to some extent by the upper fibres of the peroneus longus muscle. The branches which it gives off in its course are cutaneous and articular. The former are represented by two nerves, one of which, the *Ramus Communicans Fibularis* [ramus anastomoticus peronæus], arises from the external popliteal about the level of the knee-joint and passes downwards and slightly inwards, lying on the plantaris and the outer head of the gastrocnemius; the other, an unnamed branch, to the skin of the upper, outer, and anterior portion of the leg, either arises in common with the ramus communicans fibularis or in close proximity to it. The *articular branches* are three in number—upper, lower, and recurrent—and require great care to display. The first runs outward deep to the biceps tendon above the external condyle; the second in a similar direction, but at a lower level, deep to the external lateral ligament—an attempt should be made to find the small branch given by this last nerve to the superior tibio-fibular joint—while the third, which springs from the nerve as it lies on the neck of the fibula deep to the peroneus longus, should not be looked for at the present stage, as it will be more convenient to discover it later.

The *Internal Popliteal Nerve* [n. tibialis] runs vertically through the popliteal space from its upper to its lower angle. Deep to it are the popliteal vessels. Its branches are cutaneous, articular, and muscular. The cutaneous branch, the *Ramus communicans tibialis* [n. cutaneus suræ medialis] will be found descending in the furrow between the two heads of the gastrocnemius. Its union with the ramus communicans fibularis and its final distribution will be seen later. The articular branches are

upper, lower, and azygos; the first two pass round the inner side of the limb, the higher above the internal condyle, the

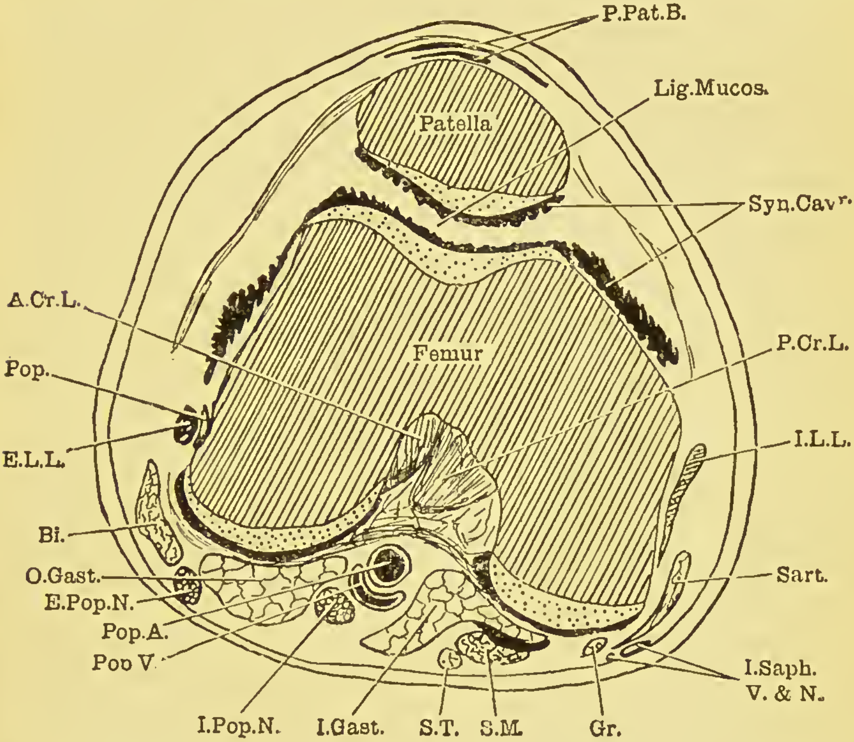


FIG. 158.—HORIZONTAL SECTION THROUGH THE LEFT THIGH AT THE LEVEL OF THE CONDYLES OF THE FEMUR. (TRACED WITH THE DIAGRAPH.)

P.Pat.B. Prepatellar Bursæ. *Lig.Mucos.* Ligamentum Mucosum rising up between those parts of the Articular Surfaces which are not, at the time, in contact. *Syn.Cav.* Synovial Cavity, showing the fringing of the Synovial Membrane. *A.Cr.L.* Anterior Crucial Ligament. *P.Cr.L.* Posterior Crucial Ligament. *I.L.L.* Internal Lateral Ligament. *E.L.L.* Long External Lateral Ligament. *Sart.* Sartorius. *I.Saph.V. & N.* Internal Saphenous Vein and Nerve. *Gr.* Gracilis. *S.M.* Semi-membranosus. *S.T.* Semi-tendinosus. *I.Gast.* Inner Head of Gastrocnemius. *O.Gast.* Outer Head of Gastrocnemius. *Pop.A.* Popliteal Artery. *Pop.V.* Popliteal Vein. *I.Pop.N.* Internal Popliteal Nerve. *E.Pop.N.* External Popliteal Nerve. *Bi.* Biceps. *Pop.* Popliteal.

lower along the oblique upper border of a deep-lying muscle, the popliteus. The *azygos articular nerve* passes directly to

the joint, piercing the posterior ligament near its central point.

The muscular branches supply the inner and outer heads of the gastrocnemius, the plantaris, soleus, and popliteus muscles; the branches to all except the last-named arise close together, and are easily traced to their destination. The branch to the popliteus, on the other hand, can only at present be traced to the lower border of that muscle round which it may be seen to wind.

In addition to the two popliteal nerves, another nerve is usually to be found deep in the popliteal space; it is the *geniculate branch of the obturator nerve.* Look for it in the upper part of the space immediately to the inner side of the popliteal artery, the deeper of the two large vessels lying under cover of the internal popliteal nerve. The branch, if traced upwards, will be seen entering the space by piercing the fibres of the adductor magnus muscle, while, if traced downwards, it will be seen to pierce the posterior ligament of the knee-joint.

Now turn to the blood vessels, viz. the *Popliteal artery and vein.* The latter is the more superficial, and may be traced first. It will be seen to receive lateral tributaries, a small median vein from the knee-joint and the large external saphenous vein already noted. Deep to the vein and in close contact with it throughout its course lies the popliteal artery, many branches of which have been met already in tracing the distribution of the nerves. The artery enters the space at its upper and inner part by passing through an opening in the adductor magnus muscle; it then inclines outwards to lie between the two condyles of the femur, from which situation it descends vertically, passing under cover of the gastrocnemius and soleus. The artery gives off various muscular and cutaneous twigs, and in addition certain articular branches which are closely associated in their course with the three articular branches of the internal popliteal nerve and the upper and lower articular branches

of the external popliteal. The muscular branches supply the superficial calf muscles, and are known as *sural arteries.*

In the removal of the fatty tissue, in which these struc-

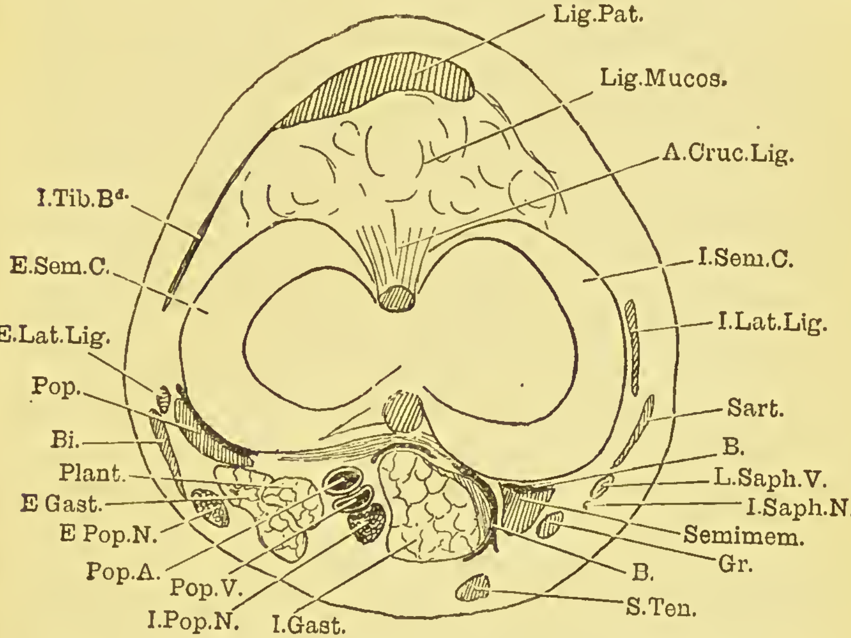


FIG. 159.—TRANSVERSE SECTION OF THE LEFT LEG THROUGH THE KNEE-JOINT. (TRACED WITH A DIOPTOGRAPH.)

Lig.Pat. Ligamentum Patellæ. *Lig.Mucos.* Fat in the Ligamentum Mucosum. *A.Cruc.Lig.* Anterior Crucial Ligament. *I.Sem.C.* Internal Semilunar Cartilage. *E.Sem.C.* External Semilunar Cartilage. *I.Lat.Lig.* Internal Lateral Ligament. *E.Lat.Lig.* Long External Lateral Ligament. *Sart.* Sartorius. *B.* Bursa. *L.Saph.V.* Long Saphenous Vein. *I.Saph.N.* Long Saphenous Nerve. *Semimem.* Semimembranosus. *Gr.* Gracilis. *S.Ten.* Semi-tendinosus. *I.Gast.* Inner Head of Gastrocnemius. *E.Gast.* External Head of Gastrocnemius. *Pop.A.* Popliteal Artery. *Pop.V.* Popliteal Vein. *I.Pop.N.* Internal Popliteal Nerve. *E.Pop.N.* External Popliteal Nerve. *Plant.* Plantaris. *Bi.* Biceps. *Pop.* Popliteus. *I.Tib.B.* Ilio-tibial Band.

tures are embedded, groups of lymph nodes will in many cases be met. There is usually one group lying upon the posterior ligament of the joint receiving the lymphatics from the inside of the articulation, another group lies along the

vessels, and there is usually one node in relation to the external saphenous vein just after it has pierced the deep fascia.

It is of surgical importance to notice that the poplitcal artery does not lie in contact with the popliteal surface of the femur, but is separated from it by half an inch of fat.

The structures within the space having been dissected out, it is now advisable to clean its boundaries. The hamstring muscles should first be cleaned, but only so far as they form the boundaries of the space. It is not convenient to carry the dissection beyond these limits at present.

In cleaning the semi-membranosus muscle and in tracing it to its insertion into the groove at the back of the inner tuberosity of the tibia, the tendon of the muscle will in most cases be seen to be separated from the bone by a well-developed bursa which may communicate with one lower down, common to the semi-membranosus and inner head of the gastrocnemius.

Deep to the inner hamstrings will be seen the *Adductor Magnus muscle and tendon,* both of which should be carefully cleaned, the opening between the two, through which the popliteal vessels enter the space, being defined. An examination of the *outer hamstring* (biceps) will show that it possesses two heads, one of which—the long—is composed of vertical fibres descending from the tuber ischii, the other—the short—of fibres passing obliquely downwards and outwards from the linea aspera and external supra-condylar ridge of the femur to join the deep aspect of the common tendon of insertion. Between the adductor magnus internally and the short head of the biceps externally a triangular portion of the femur is left almost uncovered by muscle—the so-called popliteal surface.

The lower boundary of the popliteal space on the inside is formed by the *inner head of the Gastrocnemius,* which arises from the upper and back part of the internal condyle, just below the adductor tubercle of the femur.

Deep to this origin of the inner head of the gastrocnemius lies a bursa which frequently eommunicates with the knee-joint (see Fig. 159).

The *outer head* arises from a pit on the outer surfaee of the external eondyle and from the adjaeent portion of the popliteal surfaee. In its tendon of origin a sesamoid fibro-eartilage is oecasionally present. Above and to the inner side of the outer head of the muscle the small fleshy belly of the *Plantaris* is usually to be seen arising from the popliteal surface of the femur. In a eonsiderable number of eases, however, it is absent.

The upper portion of the *Soleus* should next be exposed by separating gently with the handle of a sealpel the two fleshy heads of the gastroenemius and looking in the interval between them, when its arehed tendinous upper border will be observed. Next with the finger hook the popliteal vessels and the internal popliteal nerve to the inner side, thereby exposing mueh fat, the posterior ligament of the knee-joint, and the popliteus muscle—the latter eovered by a dense fascia. The soleus, popliteus, and the eapsule of the knee-joint will be much better studied later.

BACK OF THE THIGH

Make a median incision through the skin whieh has been left on the back of the thigh, and reflect it carefully to either side. A diligent seareh should now be made in the superfieial fascia for branches of the small seiatic nerve. The seareh is aided by pulling upon the small seiatic where it has been exposed already in the regions of the buttock and popliteal spaee. The branches are partieularly found near the middle line. They are reinforced on the outer side by the posterior branches of the external eutaneous nerve. The superfieial fascia may now be removed, and the dense deep faseia (faseia lata) binding the structures together exposed. Divide this latter faseia, thereby exposing the hamstring muscles in

their whole course with the *Great Sciatic Nerve* [n. ischiadicus], which supplies them. This nerve should be noted passing down from the buttock, lying *midway* between the great trochanter and the ischial tuberosity, first to the outer side and then deep to the biceps muscle. As a rule, half-way down the thigh it divides into the internal and external popliteal nerves; before this, however, it has given off the branches of supply to the two heads of the biceps, to the semi-tendinosus, semi-membranosus, and to that portion of the adductor magnus muscle which arises from the tuber ischii. The nerves will be found in the process of cleaning the muscles, and as a rule two nerves will be seen to enter the semi-tendinosus, one above and one below the tendinous intersection.

The origin of the hamstring muscles has already been seen and noted in the dissection of the buttock, but their exact attachment and relationships to each other may be now more clearly determined. On cleaning the tendons of origin it will be seen that the long head of the *biceps* and the *semi-tendinosus* have a common tendon, which is attached to the inner portion of the posterior surface of the tuber ischii, while the *semi-membranosus* arises from the outer portion of that surface. After a course of one or two inches the biceps and semi-tendinosus separate, the one passing outwards, the other inwards. The tendon of the semi-membranosus passes inwards under cover of the common tendon—it has the characteristic shape of a hollow-ground razor with its edge inward, the semi-tendinosus lying in the hollow. The muscular bellies of the hamstring muscles should now be cleaned down to their tendons of insertion. In this procedure a distinct tendinous intersection will be observed in the substance of the semi-tendinosus muscle. The long head of the biceps will be seen to be joined on its inner side by the short head, which, arising from the external supra-condylar ridge on the femur, passes downwards and outwards to join the tendon of insertion. When these muscles have been cleaned

and separated, a complete view will be obtained of the great sciatic nerve lying in this region on the adductor magnus muscle and supplying the muscles mentioned (see Fig. 164).

The posterior surface of the adductor magnus must next

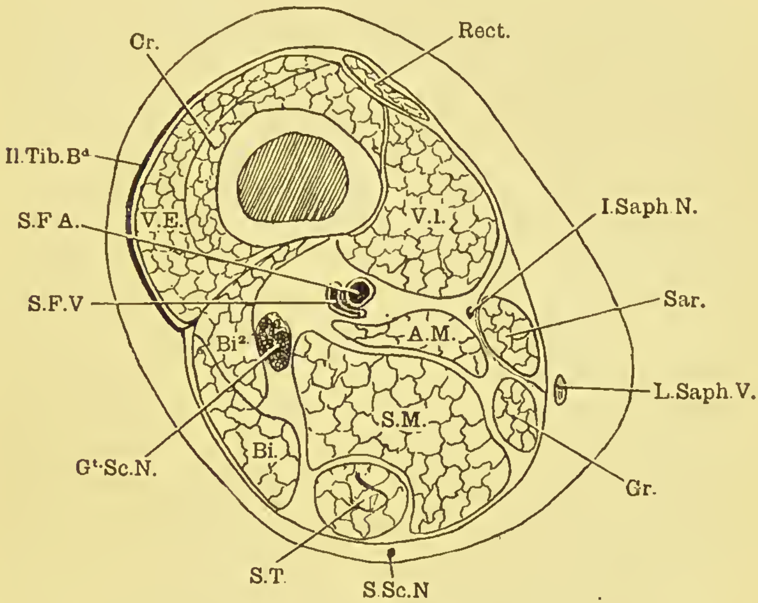


FIG. 160.—TRANSVERSE SECTION THROUGH THE LEFT THIGH AT THE LEVEL OF THE THIRD AND LOWEST QUARTERS OF THE FEMUR. (TRACED WITH A DIOPTOGRAPH.)

Rect. Rectus. *V.E.* Vastus Externus. *V.I.* Vastus Internus. *Cr.* Crureus. *I.Saph.N.* Internal Saphenous Nerve. *Sar.* Sartorius. *A.M.* Adductor Magnus. *L.Saph.V.* Long Saphenous Vein. *Gr.* Gracilis. *S.M.* Semi-membranosus. *S.T.* Semi-tendinosus. *S.Sc.N.* Small Sciatic Nerve. *Gt.Sc.N.* Great Sciatic Nerve. *Bi.* Biceps. *Bi2.* Short Head of Biceps. *S.F.V.* Superficial Femoral Vein. *S.F.A.* Superficial Femoral Artery. *Il.Tib.Bd.* Ilio-tibial Band.

be cleaned. Its upper border lies immediately below the quadratus femoris, its outer border is attached to the back of the femur below this muscle, to the linea aspera, to the upper part of the internal supra-condylar ridge, and to the adductor tubercle. Between the last two portions of its attachment is a wide gap—" the opening in the adductor

magnus"—through which the femoral artery enters the popliteal space to become the popliteal artery, and the popliteal vein leaves the space (see Fig. 160). The inner border of the adductor magnus passes downwards and outwards from the tuber ischii to the adductor tubercle. The attachment of the adductor magnus to the back of the femur and linea aspera is interrupted at four points for the passage through the muscle of the *four perforating arteries* and corresponding veins. These vessels lie directly upon the bone, and are preserved by tendinous arches from compression by the muscular fibres. The fact that they lie upon the bone prevents them from being mistaken for purely muscular twigs of variable position and importance. The four perforating arteries are not always found. Sometimes only one or two are present.

The buttock, back of thigh, and popliteal space should now be painted over with vaseline or with carbolic acid and glycerine, the skin replaced and stitched in position. In this way the parts will be preserved for future reference.

THE FRONT OF THE THIGH

Superficial Anatomy.—Identify by touch the spine of the pubis and the anterior superior iliac spine. Stretching between them a more or less distinct fibrous cord, slightly convex downwards, may be felt—the ligament of Poupart [lig. inguinale], which on this aspect is taken as the dividing line between the abdomen and thigh.

The spine of the pubis is a most important landmark in the diagnosis of hernia; it is not always easily felt, particularly in the male, because the spermatic cord lies directly in front of it.

A useful means of determining its position is to follow up the tendon of the adductor longus, always easily felt, to its attachment, or else to invaginate the scrotum from behind until the external abdominal ring in the abdominal wall is

reached, remembering that the outer pillar of this ring is attached to the spine of the pubis. The spine is almost exactly an inch from the mid line of the top of the symphysis pubis.

In front of the knee the patella can be felt with the ligamentum patellæ below it. On each side of the latter the outline of the knee-joint may be made out, especially if it be slightly moved; notice that the lower edge of the patella corresponds to the line of the joint.

The contours of the inner and outer sides of the thigh differ a good deal; on the outer side there is a slight convexity above corresponding to the gluteus medius, then a depression superficial to the great trochanter; below that a long, slight convexity formed by the vastus externus, but as the patella is approached, this fades away into a flattening or even a slight concavity. It is here that the ilio-tibial band may be felt.

On the inner side, just above the patella, is a rather marked bulging caused by vastus internus and sartorius, while above the middle of the thigh the adductor mass makes its characteristic convexity.

Below Poupart's ligament, and more to the inner than the outer side of the median line of the limb, a somewhat triangular depression can be felt, of which Poupart's ligament forms the base. This depression, which occupies the upper third of the front of the thigh, corresponds to a well-marked space in the dissected limb known as Scarpa's triangle.

Dissection.—Make an incision along the whole length of Poupart's ligament if this has not already been made by the dissector of the abdomen. From the extremities of this line make two vertical incisions to the level of the knee and reflect downwards the large flap so circumscribed.

The *Superficial Fascia* now exposed should be carefully examined for subcutaneous vessels and nerves. It will be convenient to begin with the veins, readily recognisable by their colour. The largest vein is the *Internal* or *Long*

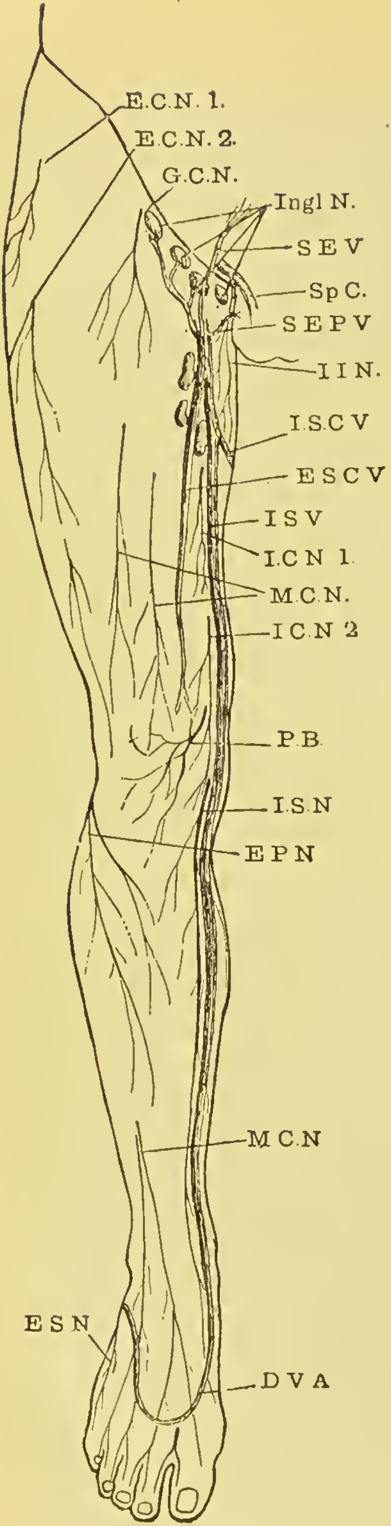


Fig. 161.—Superficial Structures in Front of Lower Limb.

E.C.N. 1, *E.C.N.* 2. Anterior Division of External Cutaneous Nerve. *G.C.N.* Genito-crural Nerve. *Ingl.N.* Inguinal Group of Lymph Nodes with Superficial Circumflex Iliac Vessels supplying them. *S.E.V.* Superficial Epigastric Vessels. *Sp.C.* Spermatic Cord. *S.E.P.V.* Superficial External Pudic Vessels. *I.I.N.* Ilio-inguinal Nerve. *I.S.C.V.* Posterior Saphenous (Internal Saphenous Collateral) Vein. *E.S.C.V.* Anterior Saphenous (External Saphenous Collateral) Vein. *I.S.V.* Internal Saphenous Vein. *I.C.N.* 1, *I.C.N.* 2. Internal Cutaneous Nerve. *M.C.N.* Middle Cutaneous Nerve. *P.B.* Patellar Branch of Long Saphenous Nerve. *I.S.N.* Long (Internal) Saphenous Nerve. *E.P.N.* Cutaneous Branches of External Popliteal Nerve. *M.C.N.* Musculo-cutaneous Nerve. *D.V.A.* Dorsal Venous Arch. *E.S.N.* Short (External) Saphenous Nerve.

Saphenous, and will be found passing upwards and slightly forwards from the inner side of the knee to end by piercing the deep fascia through a large but somewhat indistinct opening—the *Saphenous Opening*—the centre of which is about an inch and a half below and external to the pubic spine. Entering the long saphenous vein from below, there will be usually seen two large tributaries, one from the antero-external aspect of the thigh—the *anterior saphenous* —the other from the postero-internal aspect—the *posterior saphenous.* The position of the internal saphenous vein and its relation to these two tributaries should be carefully noted, for the vein is not infrequently ligatured, or a portion of it excised, in the treatment of varicose veins. Entering the vein from above are three small veins, the *superficial external pudic* [v. pudenda externa superficialis], the *superficial epigastric,* and the *superficial circumflex iliac,* from within outward. The veins should be merely exposed, as it is not advisable to clean them thoroughly until the other structures are identified. With the three above-named tributaries of the internal saphenous vein the student will have no difficulty in recognising small corresponding arteries—the *superficial external pudic,* the *superficial epigastric,* and the *superficial circumflex iliac.* At a lower level and on a deeper plane than the first of these arteries, another may be seen close to the inner limit of the area exposed; it is the *deep external pudic* artery [a. pudenda externa profunda].

A more difficult task faces the student in the dissection of the superficial nerves, since not only are they small, but are liable to be mistaken for lymphatic vessels or strands of fascia. It is clearly important that he should know the exact spot in which to look for the particular nerves.

The *Ilio-inguinal nerve* will be found close to the pubic spine, and to the outer side of the spermatic cord, which is usually exposed at the upper and inner angle of the dissection. It is distributed to the skin of the scrotum and root of the penis in the male as well as to that part of the skin of

the thigh in contact with the genitalia. In the female it supplies the labium majus.

The *crural branch of the Genito-crural Nerve* [N. genito-femoralis] is to be found immediately external to the femoral artery, which latter vessel can be readily felt by pressure with the finger at a point midway between the anterior superior iliac spine and the symphysis pubis. Having identified the artery, make a vertical incision in the superficial fascia two inches in length along the course of the artery, beginning at Poupart's ligament. Tease the superficial fascia in the line of the incision, and keep a sharp look out for fine nerve filaments, which, when found, will lead to the main trunk lying on the outer side of the femoral artery (Fig. 161).

The *iliac branch of the Ilio-hypogastric nerve* frequently supplies a small area of skin on the front of the thigh, a little below the anterior superior iliac spine. The superficial fascia in this region should be therefore examined for a few fine twigs from this source.

The lower two-thirds of the front of the thigh are supplied by the Internal, Middle, and External Cutaneous Nerves, which are joined in the region of the patella by the patellar branch of the long saphenous nerve. The main branch, or anterior division of the *Internal Cutaneous Nerve* [rami cutanei anteriores nervi femoralis], in this region will be found piercing the deep fascia at the junction of the upper two-thirds with the lower third of the thigh, at the inner border of the sartorius muscle. In the superficial fascia above this point, however, a few small additional twigs from this nerve may be found if careful search is made. The posterior division of the *External Cutaneous Nerve* [n. cutaneus femoris lateralis] has already been sought in the dissection of the buttock. The anterior division pierces the deep fascia about four inches below the anterior superior iliac spine. The *Middle Cutaneous Nerve* is, as a rule, represented by two well-marked branches, which descend vertically an inch or so apart, close to the median axis of the

limb. They usually pierce the deep fascia about five inches below Poupart's ligament. In finding these nerves the incisions into the superficial fascia should be made in the line of the nerves, viz. vertically.

The *patellar branch of the long Saphenous Nerve* may be recognised by the fact that, to become cutaneous, it usually pierces the lower part of the sartorius muscle. If the nerves just mentioned, viz. the anterior divisions of the internal and external cutaneous nerves, the middle cutaneous nerve, and the patellar branch of the long saphenous nerve, be traced to their termination, they will be found to form a delicate plexus in front of the patella—the so-called *Patellar Plexus* (see Fig. 161).

The Lymphatic Vessels and Nodes should next be examined. No doubt many of the lymphatic vessels will have been met in the dissection of the superficial nerves. They are found in all parts of the superficial fascia, and are traceable to the *Superficial Inguinal Nodes* or *Glands* [lympho-glandulæ subinguinales], which are arranged more or less uniformly around the saphenous opening.

These nodes are usually divided into a horizontal and a vertical group; the former lie just below Poupart's ligament and are from two to five in number. They drain the skin of the genital organs, the lower part of the abdomen and the buttock, while the vertical set usually forms two parallel rows, one large node being almost invariably found between the internal and anterior saphenous veins. These drain the lower extremity, and are so constantly to be felt through the skin that they are used by many surgeons as guides to the saphenous vein.

The superficial fascia may now be removed, preserving as far as possible the superficial vessels and nerves.

The deep fascia now exposed is remarkable for its tendinous nature; it is known as the *Fascia Lata*, and it surrounds the thigh in its whole circumference like a tight-fitting sleeve. It has a number of small apertures for the vessels

and nerves, and one large aperture, the *Saphenous opening* [fossa ovalis], for the long or internal saphenous vein.

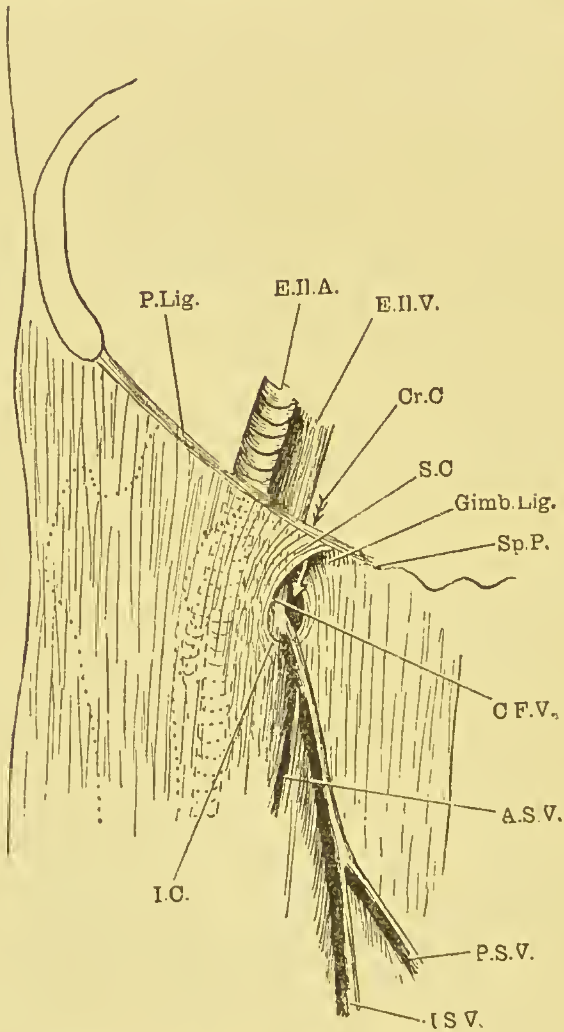


FIG. 162.—THE SAPHENOUS OPENING.

P.Lig. Poupart's Ligament. *E.Il.A.* External Iliac Artery. *E.Il.V.* External Iliac Vein. *Cr.C.* Arrow passed through the Crural Canal. *S.C.* Superior Cornu of Falciform Edge. *I.C.* Inferior Cornu of Falciform Edge. *Gimb.Lig.* Gimbernat's Ligament. *Sp.P.* Spine of Pubis. *C.F.V.* Common Femoral Vein. *A.S.V.* Anterior Saphenous Vein. *P.S.V.* Posterior Saphenous Vein. *I.S.V.* Internal Saphenous Vein.

This opening, as already stated, has its centre an inch or so below and external to the pubic spine. It is somewhat crescentic in shape, the concavity of the crescent being directed inward and the horns being situated above and below. The opening is to some extent obscured until a thin fascia which covers it—the *cribriform fascia*—has been removed. Passing through the opening, in addition to the internal saphenous vein, are a few small blood-vessels and a number of lymphatics. The opening is of great practical importance, for through it a femoral hernia passes on its way to the surface (see Fig. 162).

Through the deep fascia the boundaries of the triangular depression—*Scarpa's triangle* [trigonum femorale]—will now be seen. The base is formed by the ligament of Poupart; the apex is below and internal. From the apex there passes, upward and inward, the inner border of the adductor longus, and upward and obliquely outward, the inner border of the sartorius. The deep fascia should now be incised along the boundary lines of this triangle and removed, care being taken to preserve the subcutaneous structures already dissected. In this way Scarpa's triangle will be opened up and its contents readily found. In all regions identification of the separate structures should precede their complete dissection, and this is particularly true in this instance.

The long saphenous vein will be the best guide to the *common femoral vein* into which it opens. As soon as this latter vein has been identified, take one of the superficial arteries, and, by following it, the common femoral artery will be found. Next take the middle cutaneous nerve, and by tracing it upwards the anterior crural nerve, lying to the outside of the femoral artery, will be reached.

An effort should now be made to find the nerve to the Pectineus, for if it is not found now it is liable to be cut in the further dissection of the part. Gently insinuate a finger of one hand to the outer side of the femoral artery and pull that vessel inwards, while with a finger of the other hand the

anterior crural nerve is pulled outwards. If the interval between these two structures is now looked at, a fair-sized nerve should be seen, descending downwards and inwards from the anterior crural nerve and disappearing deep to the femoral artery, or between it and a large branch—the deep femoral.

Having found this nerve, the dissector may now pass to the systematic dissection of the space. As the nerves are most liable to injury, it is well to begin with them.

The ilio-inguinal, genito-crural, and external cutaneous nerves have been found already; they therefore only need careful reflecting.

The branches of the *Anterior Crural Nerve* [N. femoris] must next be followed. Of these the nerve to the pectineus has been already exposed, as well as the internal and middle cutaneous nerves. The last of these is in no danger of being cut, but the internal cutaneous may be, unless it be remembered that it passes downwards and inwards from its origin to cross the femoral artery, it being the only nerve crossing that artery in Scarpa's triangle.

In tracing the branches of the anterior crural nerve it is not a bad plan to pass a pencil or a piece of wood deep to the trunk of the nerve as it appears under Poupart's ligament, thereby putting it upon the stretch.

The *nerve to the sartorius* should be found next. It may be a direct and separate branch from the anterior crural, or, which is more frequent, it may be in a common sheath with the outer of the two middle cutaneous nerves.

In some cases the branches of the anterior crural nerve will be seen to be divided into a superficial and a deep set by an artery—the external circumflex or one of its branches. In such a case the superficial branches will be the internal and middle cutaneous nerves, and the nerves to the sartorius and pectineus (see p. 378).

The deep branches will be seen passing downwards, to disappear deep to the sartorius muscle; some of them enter

the large muscular mass on the front of the thigh, the quadriceps extensor. Their destination will be fully displayed later.

The position of the nerves being carefully borne in mind, clean the floor of the triangle from without inwards, noticing that in this direction its floor is formed by the iliacus, psoas, pectineus, and adductor longus.

Sometimes the edges of the adductor longus and pectineus do not touch, in which case the adductor brevis is seen between them, but on a deeper plane. In cleaning the surface of this muscle care must be taken not to injure the *anterior division of the obturator nerve,* which lies vertically in front of (superficial to) it (see Fig. 163).

When the inner and lower border of the triangle is reached a small branch of the obturator nerve should be looked for, appearing from under cover of the adductor longus, and disappearing deep to the sartorius to join the *subsartorial plexus.*

A number of large arteries will now be seen. The *Common Femoral* has already been noticed as the continuation of the external iliac. Abduct the thigh a little and rotate it outwards, then stretch a piece of string from the point midway between the anterior superior iliac spine and symphysis pubis to the back of the inner condyle. This line corresponds to the common and superficial femoral arteries in the upper two-thirds of the thigh.

The bifurcation of the common femoral is $1\frac{1}{2}$ to 2 inches below Poupart's ligament, after which the superficial and deep femoral arteries must be studied. The *Superficial Femoral artery* continues the line of the common femoral, down to the apex of Scarpa's triangle, and gives off no branches of any importance in the triangle.

The *Deep Femoral artery* [Profunda femoris] is equal in size to the superficial; it runs at first downwards and outwards for about an inch and then gives off its external circumflex branch, after which it changes its direction and

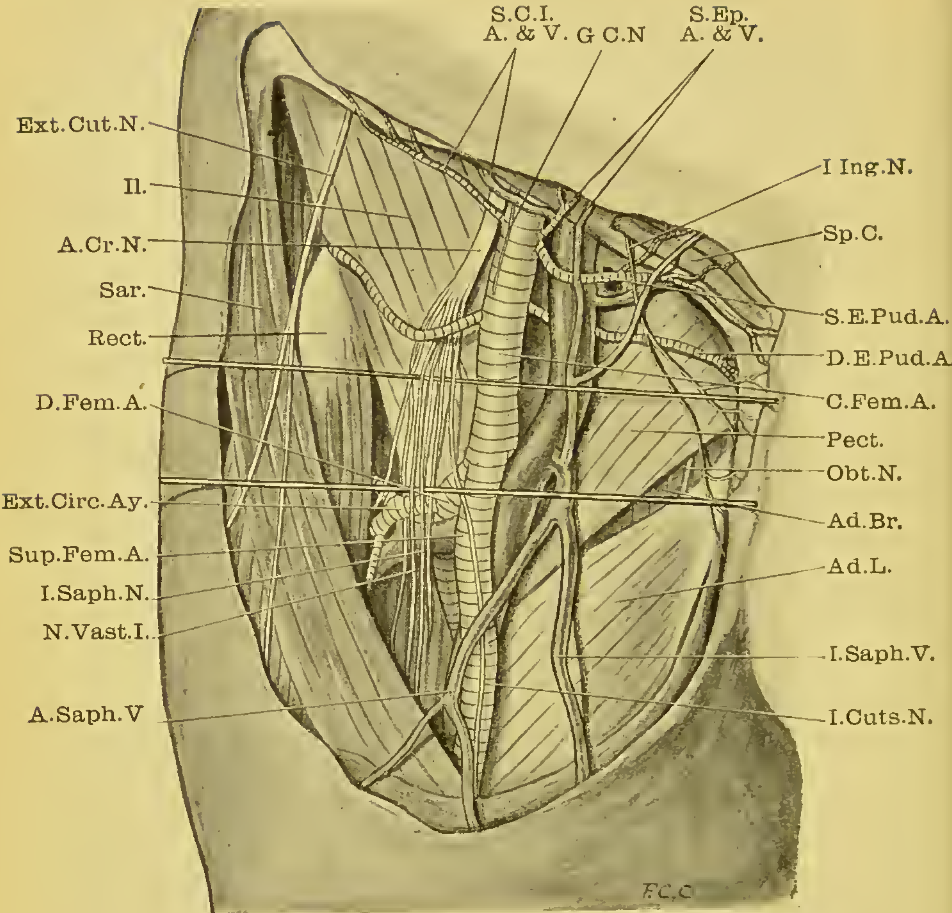


FIG 163.—DISSECTION OF SCARPA'S TRIANGLE.

S.C.I.A. and V. Superficial Circumflex Iliac Artery and Vein. *G.C.N.* Genito-crural Nerve. *S.Ep.A. and V.* Superficial Epigastric Artery and Vein. *I.Ing.N.* Ilio-inguinal Nerve. *Sp.C.* Spermatic Cord. *S.E.Pud.A.* Superficial External Pudic Artery. *D.E.Pud.A.* Deep External Pudic Artery. *C.Fem.A.* Common Femoral Artery. *Pect.* Pectineus. *Obt.N.* Anterior Division of Obturator Nerve. *Ad.Br.* Adductor Brevis. *Ad.L.* Adductor Longus. *I.Saph.V.* Internal Saphenous Vein. *A.Saph.V.* Anterior Saphenous Vein. *I.Cuts.N.* Internal Cutaneous Nerve. *N.Vast.I.* Nerve to Vastus Internus. *I.Saph.N.* Internal Saphenous Nervo. *Sup.Fem.A.* Superficial Femoral Artery. *D.Fem.A.* Deep Femoral Artery. *Ext.Circ.A.* External Circumflex Artery. *Rect.* Rectus Fomoris. *Sar.* Sartorius. *A.Cr.N.* Anterior Crural Nerve. *Il.* Iliacus. *Ext.Cut.N.* External Cutaneous Nerve.

runs downwards, backwards, and inwards, passing deep to the superficial femoral.

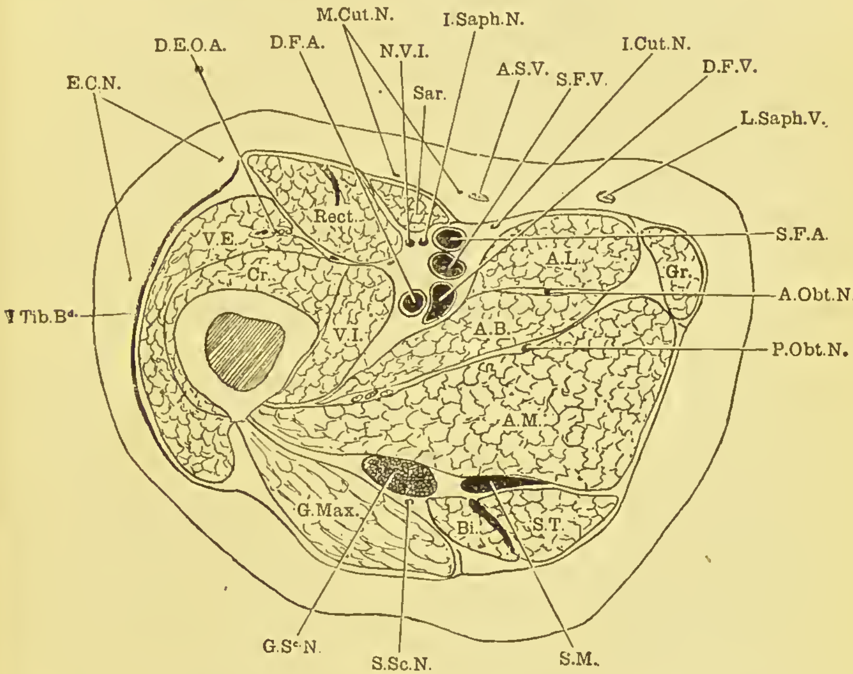


FIG. 164.—TRANSVERSE SECTION OF THE LEFT THIGH AT THE JUNCTION OF THE UPPER AND SECOND QUARTER OF THE FEMUR. (TRACED WITH A DIOPTOGRAPH.)

E.C.N. External Cutaneous Nerve. *D.E.C.A.* Descending Branch of External Circumflex Artery. *Rect.* Rectus. *D.F.A.* Deep Femoral Artery. *M.Cut.N.* Middle Cutaneous Nerve. *N.V.I.* Nerve to Vastus Internus. *Sar.* Sartorius. *I.Saph.N.* Internal Saphenous Nerve. *A.S.V.* Anterior Saphenous Vein. *S.F.V.* Superficial Femoral Vein. *I.Cut.N.* Internal Cutaneous Nerve. *D.F.V.* Deep Femoral Vein. *L.Saph.V.* Long Saphenous Vein. *S.F.A.* Superficial Femoral Artery. *A.L.* Adductor Longus. *Gr.* Gracilis. *A.Obt.N.* Anterior Branch of Obturator Nerve. *P.Obt.N.* Posterior Branch of Obturator Nerve. *A.B.* Adductor Brevis. *A.M.* Adductor Magnus. *S.M.* Semi-membranosus. *S.T.* Semi-tendinosus. *Bi.* Biceps. *S.Sc.N.* Small Sciatic Nerve. *G.Sc.N.* Great Sciatic Nerve. *G.Max.* Gluteus Maximus. *I.Tib.B.* Ilio-tibial Band. *V.E.* Vastus Externus. *Cr.* Crureus. *V.I.* Vastus Internus.

The superficial and deep femoral arteries are separated in Scarpa's triangle by the superficial and deep femoral veins,

so that a transverse section of the thigh near the apex of the triangle would divide first the superficial femoral artery, then the superficial femoral vein, then the deep femoral vein, and, deepest of all, the deep femoral artery.

The *Internal Circumflex Artery* [A. circumflexa femoris medialis] will be found rising from the deep femoral on its posterior (deep) surface, close to its commencement; it proceeds directly backwards, passing through the floor of the triangle between the pectineus and ilio-psoas. Its terminations, it will be remembered, were seen in the buttock, the ascending branch appearing at the upper, the transverse at the lower border of the Quadratus Femoris. The *External Circumflex Artery* [A. circumflexa femoris lateralis], on the other hand, runs outwards, separating, in some cases, the branches of the anterior crural nerve into superficial and deep sets, and leaves the triangle by passing under cover of the sartorius. It usually rises below the origin of the internal circumflex. The external circumflex artery breaks up into three branches or sets of branches: (*a*) an ascending, which ends by associating itself with the nerve to the tensor fasciæ femoris; (*b*) a transverse, which anastomoses with the corresponding branch of the internal circumflex; and (*c*) descending, which associates itself with the nerve to the vastus externus. Veins corresponding to these arteries will be found opening into the common femoral vein. It may be further noted that, while the common femoral vein lies to the inner side of its artery above, it tends to lie more and more behind the artery as it is traced downwards, and that after the deep femoral artery has also passed behind the superficial femoral the two arteries are separated from each other by the two veins.

Many anatomists prefer to describe these great arteries differently. Instead of speaking of a common femoral trunk which divides into two terminal branches, superficial and deep femoral, they regard the common and superficial femoral as one long trunk—the femoral artery—which gives

off the deep femoral as a branch. In deference to the needs of surgeons, we have adhered to the former and older description, but the latter and more modern is valuable in emphasising the fact that the superficial femoral artery directly continues the line of the common femoral.

Two or three *Deep Inguinal Lymph Nodes* lie to the inner side of the femoral vein, just below Poupart's ligament. In fact, one of them can occasionally be seen lying in the loose areolar tissue deep to Poupart's ligament, in the *crural canal* [canalis femoralis]. The latter term is applied to a small space under the ligament and immediately to the inner side of the femoral vein. The index finger can be readily passed up into it, as it is only occupied by loose areolar tissue and the above-mentioned deep inguinal gland. The opening is of considerable practical importance, for through it a femoral hernia makes its way out of the abdominal cavity (see Fig. 162). Its boundaries, therefore, should be carefully noted. They are, in front, Poupart's ligament; behind, the pectineus covered by a thick fascia continuous with the portion of fascia lata on the inner side of the saphenous opening; internally, the sharp edge of *Gimbernat's ligament* [lig. lacunare]; externally, the femoral vein. In operations for the return of the hernia into the abdominal cavity it becomes necessary to enlarge this opening, and the student should observe that this is most readily done by cutting inward through Gimbernat's ligament, thereby releasing Poupart's ligament and allowing the opening to be enlarged in both an internal and anterior direction. On no account should the surgeon cut outwards, for if he does he must inevitably cut into the femoral vein.

Scarpa's triangle may now be left, although the parts underlying its floor have still to be examined. Note at this stage that the floor is not flat, but that the internal part, and to a less extent the external, both slope backwards to meet at an angle which is occupied by the common femoral vessels (see Fig. 164).

Make a transverse incision about 3 inches long through the fascia lata, one to two inches below the apex of Scarpa's triangle, thereby keeping a band of fascia lata in position. From this incision carry an oblique incision downwards, following the line of the sartorius muscle as far as the upper border of the patella, at which level a second transverse incision should be made. Carefully turn the fascia inwards and outwards, preserving the cutaneous nerves. The muscular fibres of the *Sartorius* will now be distinctly seen. Free the sartorius along its outer border and gently pull it inwards, thereby exposing a strong process of the fascia lata —the *subsartorial fascia*—which, passing from the extensor muscles on the outside to the adductor muscles on the inside, roofs over a narrow intermuscular space known as *Hunter's Canal* [canalis adductorius], in which lie the superficial or femoral vessels and certain branches of the anterior crural nerve. It is by incising the subsartorial fascia that the superficial femoral artery is reached in the operation of ligaturing the artery in Hunter's Canal (see Fig. 165).

Before incising this fascia, however, the student should endeavour to expose a fine *subsartorial nerve plexus*, which lies immediately deep to the sartorius, and is formed of branches from the obturator, long saphenous, and internal cutaneous nerves. The easiest branch to find is the one already mentioned, derived from the obturator nerve, and the guide to it is the inner border of the adductor longus muscle. Search should therefore be made along that line if the nerve has not already been observed in the dissection of Scarpa's triangle. The nerve once found will lead the dissector down to the plexus. Now incise the subsartorial fascia, so directing the incision that the nerves forming the plexus, and particularly the twig from the long saphenous nerve, escape injury. *Hunter's Canal*, as already defined, is now opened, and its contents and boundaries can be studied. The most superficial structure is the *long saphenous nerve*, which will be seen crossing the artery from without inwards

and giving off the small twig to the subsartorial plexus. To the outer side of the long saphenous nerve is another nerve of somewhat similar size—the *nerve to the vastus internus muscle*—into which it sinks on its internal aspect.

Lastly, if these nerves with the underlying vessels be pulled outwards, thereby exposing the anterior surface of the adductor magnus muscle, a small nerve may be seen descending on that surface of the muscle and making for the inner aspect of the femoral vessels. It is the *Geniculate branch of the Obturator nerve,* already traced to its destination in the dissection of the popliteal space.

The nerves having been found, the dissector may proceed more boldly with regard to the other contents. Clean the superficial femoral artery within the limits of the space. Only one branch—the *anastomotica magna*—will, as a rule, be seen to spring from it; it quickly divides into a superficial and a deep division, the former associating itself with the long saphenous nerve, the latter with the nerve to the vastus internus. Behind the artery lies the superficial femoral vein, which receives an anastomotic tributary corresponding to the anastomotica magna artery. Now clean the walls of the canal, thereby exposing the fibres of the vastus internus on the outside, on the inside, the adductors longus and magnus, which blend closely below. The femoral vessels pass downwards and inwards, leaving the canal and entering the popliteal space through the opening in the adductor magnus. In this transit they may be accompanied by the geniculate branch of the obturator nerve, though this, in many cases, pierces the muscle at a higher level.

The two regions of Scarpa's triangle and Hunter's canal having now been separately studied, the remaining band of fascia lata holding the parts in position may be cut through and the two spaces joined. By this procedure it will be possible to obtain an extensive view of the structures on the front of the thigh.

Clean the whole of the anterior surface of the *Adductor*

Longus from its origin to its insertion. Note that it arises by a flattened tendon from the body of the pubis, below the

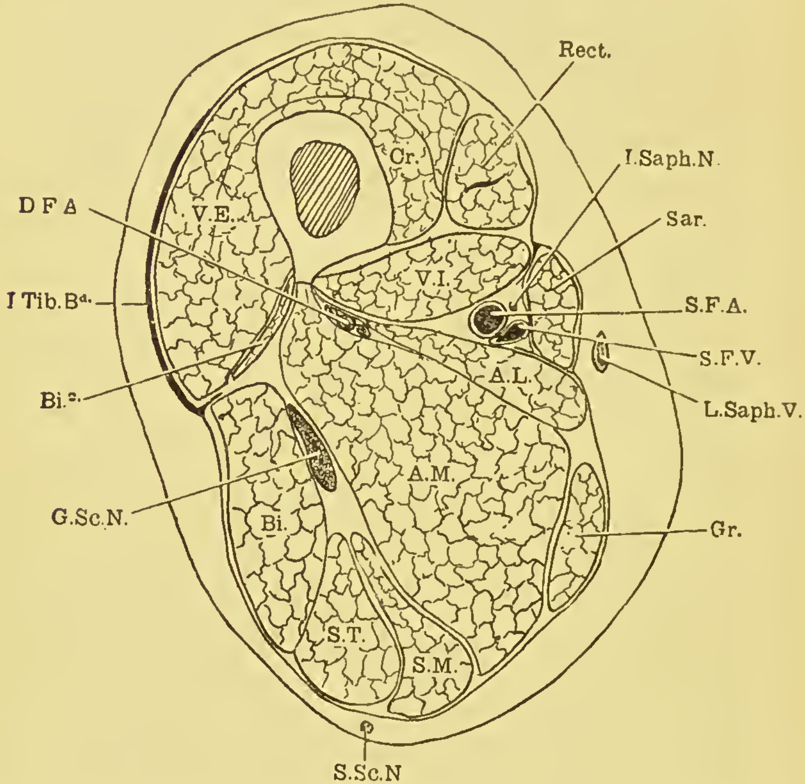


Fig. 165.—Transverse Section through the Left Thigh at the Middle of the Femur. (Traced with a Dioptograph.)

V.E. Vastus Externus. *Cr.* Crureus. *V.I.* Vastus Internus. *Rect.* Rectus. *I.Saph.N.* Internal Saphenous Nerve. *Sar.* Sartorius. *S.F.A.* Superficial Femoral Artery. *S.F.V.* Superficial Femoral Vein. *L.Saph.V.* Long or Internal Saphenous Vein. *A.L.* Adductor Longus. *A.M.* Adductor Magnus. *Gr.* Gracilis. *S.M.* Semi-membranosus. *S.T.* Semi-tendinosus. *Bi.* Biceps. *S.Sc.N.* Small Sciatic Nerve. *G.Sc.N.* Great Sciatic Nerve. *Bi.*[2]. Short Head of Biceps. *I.Tib.B*[d]. Ilio-tibial Band. *D.F.A.* Deep Femoral Artery and Veins.

pubic spine, and about half an inch from the median line. Its fibres spread out into a relatively broad muscular sheet, which is inserted into the inner lip of the linea aspera of the

femur. With the handle of the scalpel free the muscle, just below its tendon of origin, from underlying structures, and divide it, turning the muscle downwards, when its nerve of supply, sinking into its deep surface, will be apparent. Clean the deep surface of the muscle, preserving its nerves and any accompanying vascular structures. The muscle which is exposed by this reflexion of the adductor longus is the adductor brevis, the anterior surface of which is covered with fat, in which lie the *anterior division of the Obturator Nerve*, and the branches derived therefrom to the adductor longus, adductor brevis, adductor gracilis, femoral artery, subsartorial plexus, and the hip-joint. With care most of these branches are readily found. Also lying on the anterior surface of the adductor brevis will be seen the *deep femoral artery* [a. profunda femoris], with its accompanying vein. Several branches will be observed to spring from this artery, some of which pass to adjacent muscles, whilst others, lying directly on the bone, disappear through fibrous arches developed in the substance of the adductor brevis and adductor magnus muscles at their insertion. These arteries, from their course, have received the name of *perforating arteries*, and they are usually three or, if the termination of the profunda artery be included, four in number. Next clean the anterior surface of the *adductor brevis* from origin to insertion. Note that it arises from the body of the pubis and the upper portion of the pubic arch. Its origin from the body of the pubis is slightly farther from the middle line than is that of the adductor longus. It passes outwards to be inserted into the linea aspera above and behind the adductor longus, reaching almost as high as the small trochanter. Now treat the adductor brevis in a similar manner to that adopted with the adductor longus, viz. separate it near its origin from underlying structures, divide it, and turn it downward. In doing this a branch from the deep division of the obturator nerve may be found entering its deep surface. By the reflexion of this muscle the adductor magnus will be fully exposed, with

the *deep division of the Obturator Nerve* lying in front of it. From this division are derived the branches to the adductor magnus, the geniculate branch already mentioned, and a branch to the obturator externus. This last branch is not at present exposed, lying, as it does, deep to the obturator externus muscle. Clean the *Adductor Magnus* from origin to insertion, and note that it arises from the pubic arch and the outer part of the inferior surface of the tuber ischii, and that it is inserted into the femur along a line which, beginning above, close to the gluteal ridge, passes down to the upper part of the internal supra-condylar ridge, from whence it runs, by means of a fibrous arch, to the adductor tubercle. The upper border of the muscle should be very carefully defined, as it lies in close proximity to the lower border of the *obturator externus*, the origin of which, from the external surface of the obturator membrane, may be exposed by dividing the pectineus. After this its tendon should be traced behind the neck of the femur to the digital fossa.

By the above dissection a narrow strap-like muscle, the *Adductor Gracilis*, will have been exposed, descending vertically along the inner aspect of the thigh. It arises from the body of the pubis and the pubic arch to the median side of the adductor brevis. Its insertion will be seen later. A nerve has been already traced to it from the superficial division of the obturator.

The origin of the *Sartorius* muscle must next be examined. It arises from the anterior superior iliac spine, and from the anterior border of the ilium, a little below the spine. The muscle should be divided about its middle, and turned upwards and downwards.

The *Quadriceps Extensor Cruris* muscle is now exposed, and should be carefully cleaned. In this procedure it is best to begin by following the branches of the anterior crural nerve to the different divisions of the muscle. The quadriceps extensor consists of four more or less separate portions: the rectus femoris, vastus externus, vastus internus, and crureus.

The *Rectus Femoris* is the most superficial portion lying between the two vasti and hiding from view the crurcus. It is the only portion which arises from the innominate bone, and it therefore acts as a flexor of the hip-joint as well as an extensor of the knee. The rectus arises by two heads—the straight head from the anterior inferior iliac spine, the reflected head from the dorsum ilii above the acetabulum, where, as already noticed, its fibres are closely incorporated with the capsular fibres of the hip-joint. Its nerve comes from the deep division of the anterior crural, and from it a twig to the front of the hip-joint may possibly be traced. The muscle passes downwards to form the superficial part of the central portion of the quadriceps extensor insertion. The muscular mass to the outer and inner side of the rectus is formed of the vastus externus [v. lateralis] and vastus internus [v. medialis] muscles. Free the rectus femoris from the underlying muscular substance and, at the junction of the upper and middle thirds of the thigh, cut it through, and turn the lower part down. The *Vastus Externus* portion of the muscle should be now examined; at its upper origin it is distinct from the neighbouring parts of the common muscular mass, arising from the upper part of the spiral line of the femur, the base of the great trochanter, the gluteal ridge in front of the gluteus maximus, and a part of the linea aspera. The descending branch of the external circumflex artery, accompanied by the nerve to the vastus externus, forms a good guide to the line of separation between that muscle and the crureus. The separation between the *vastus internus* and *crureus* [vastus intermedius] is nowhere distinct, but an attempt should be made to find the line of union. It lies along the rounded border of the femur, between the anterior and internal surfaces. If the common muscular mass is carefully cleaned, it is in many cases possible to distinguish a difference in the direction of the fibres along the line, the fibres of the crureus portion running vertically, while those of the vastus internus

run obliquely downwards and forwards. Help in discriminating between the two parts is also often furnished by a long slender nerve which runs along the line of division. It is a branch to a few muscular fibres which have become delaminated from the deep surface of the crureus and are known as the subcrureus, which muscle will be seen later. In many cases the vastus internus and crureus will be found to be so united that no separation is possible—other than an artificial one. If the natural line of separation has been found, it will be seen that the vastus internus does not arise from the internal surface of the femur, but merely lies upon it; the crureus, on the other hand, arises from both the anterior and external surfaces of the bone. The vastus internus arises from the lower three-quarters of the spiral line, the inner lip of the linea aspera, and the tendon of the adductor magnus.

It should be here noted that the fibres of the vastus internus reach lower down than do those of the vastus externus, and that some of them have a direct insertion into the inner border of the patella. This arrangement of vasti muscles explains the difference which is to be observed between the inner and outer side of the limb in this region in the living subject. From the lower borders of both vasti muscles a strong fibrous expansion is given to the capsule of the knee-joint, to which the names external and internal *lateral patellar ligaments* have been applied. The branch from the anterior crural nerve to the vastus internus should be carefully dissected. It will be seen to break up into a number of smaller branches which enter the internal surface of the muscle at various levels. One or other of the lower branches can be traced through the muscle to the knee-joint. The nerve and its branches are accompanied by the deep division of the anastomotica magna artery.

The *crureus muscle* [vastus intermedius] arises from the anterior and external surfaces of the shaft of the femur in its upper two-thirds, and ends by forming the deep central por-

tion of the quadriceps extensor tendon. It is supplied by two or three nerves which pierce its anterior surface; the innermost of these sends a long slender branch, to which reference has already been made, down along the line of separation between the crureus and vastus internus. It is the nerve to the subcrureus, and should not be traced further until that muscle is exposed. Make a vertical median incision through the crureus right down to the bone, and turn the two parts aside. It will now be noticed that the muscle rises by a series, usually five, of transverse fleshy bars separated by loose connective tissue.

Below the origin of the crureus the *subcrureus* is seen. It consists of three or four thin laminæ, which arise one above the other from the anterior surface of the shaft of the femur below the origin of the crureus. It is inserted into the upper part of the synovial membrane of the knee-joint. The nerve to the subcrureus should now be followed, when it will be seen to supply both the muscle and the adjacent synovial membrane.

The Hip-joint

It is now convenient to examine the hip-joint; after which the limb may be removed from the trunk. Cut through the various muscles covering the joint and reflect them upward and downward. In reflecting the ilio-psoas muscle a distinct bursa is usually seen, which in many cases will be found to communicate directly with the cavity of the joint. Further, the reflected head of the rectus femoris and the tendon of the gluteus minimus are more or less incorporated with the capsule of the joint. Having cleared away surrounding structures, the student should now clean the capsule, in which procedure considerable assistance will be obtained by altering from time to time the position of the limb. The capsule consists of fibres which pass from the circumference of the acetabulum above to the spiral line of

the femur below and in front, and to an inch internal to the inter-troehanteric line below and behind. The strongest portion is in front, and is formed by a band whieh, deseending from the region of the anterior inferior iliae spine, spreads out below, and is attached to the spiral line as low as the level of the lesser trochanter. It is called the *Ilio-femoral ligament*, and is very seldom torn in any disloeation of the joint. Two other thiekened bands should be looked

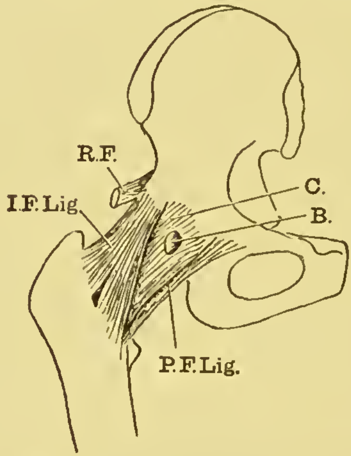


FIG. 166.—HIP-JOINT FROM IN FRONT.

R.F. Rectus Femoris. *I.F.Lig.* Ilio-femoral Ligament. *P.F.Lig.* Pubo-femoral Ligament. *C.* True Capsule. *B.* Bursa deep to Psoas communicating with Joint.

for; the *ischio-femoral* at the upper and baek part of the eapsule, coneentrating its fibres on the digital fossa, and the *pubo-femoral* at the lower part. This last band is attaehed to the pubis below the ilio-peetineal eminence and runs to the femur in front of the lesser trochanter. The weakest portion of the capsule, on the other hand, is below and behind, and it is through this part that the head of the femur almost invariably passes in disloeations. The limb should be manipulated so as to bring the head of the bone forcibly against this portion of the capsule, the thinness of

which will then become evident. Now open the joint by a vertical incision through the anterior half of the capsule.

This will show the real thickness of the ilio-femoral ligament, which is greater at times than that of the tendo Achillis. If the ligament is followed towards the femur between the finger and thumb, it will usually be felt to divide into an upper and lower thickened part diverging like

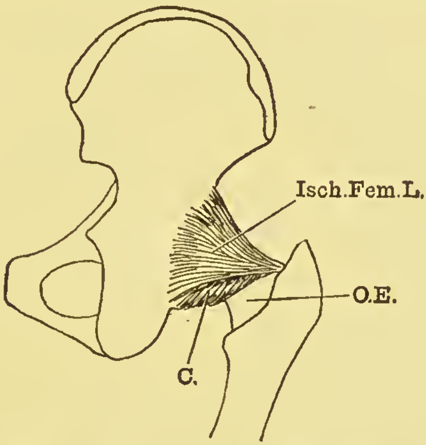


FIG. 167.—HIP-JOINT FROM BEHIND.

Isch.Fem.L. Ischio-femoral Ligament. *C.* Zonular Fibres of Capsule. *O.E.* Bare Surface of Neck for Obturator Externus Muscle.

the limbs of a Y. For this reason it is often known as the "Y-shaped ligament."

On looking into the interior a more or less cylindrical band, the *ligamentum teres*, will be observed passing from the bottom of the acetabulum to a pit on the head of the femur. This ligament is usually torn in any dislocation. By a vertical sweep of the knife through the posterior half of the capsule complete the circular incision, divide the ligamentum teres near its femoral attachment and remove the limb. If the inside of the femoral half of the capsule be examined, its fibres will be seen to be reflected along the neck of the femur from their attachment in the form of

fibrous bands, the *retinacula.* These bands contain blood vessels, and play an important part in conveying blood to the intra-capsular portion of the femur. If the cut surface of the ligamentum teres be examined, a small branch of the internal circumflex or obturator artery will be noticed, an important source of vascular supply to the head of the femur.

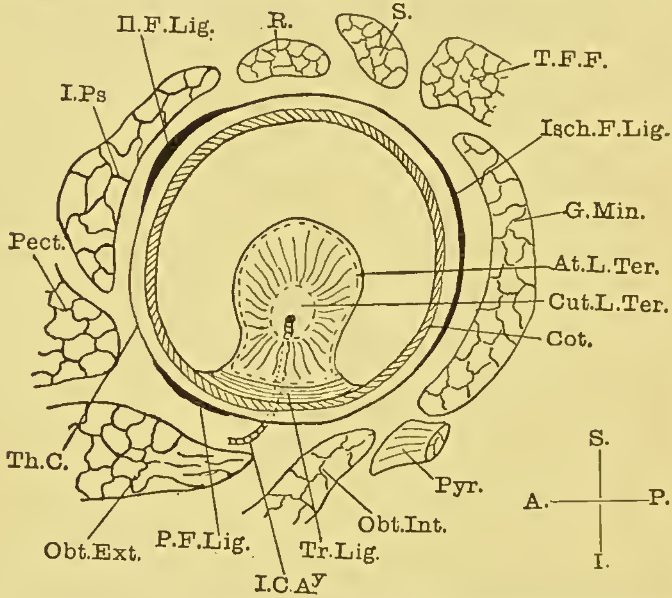


FIG. 168.—DIAGRAM OF THE INSIDE OF THE LEFT HIP-JOINT WITH THE MUSCLES IN CONTACT WITH THE CAPSULE.

Il.F.Lig. Ilio-femoral Ligament in Section. *Isch.F.Lig.* Ischio-femoral Ligament in Section. *P.F.Lig.* Pubo-femoral Ligament. *Th.C.* Thin Capsule. *Tr.Lig.* Transverse Ligament. *L.Ter.* Ligamentum Teres.
I.C.Ay Branch from Internal Circumflex Artery.

Now turn to the acetabular half of the capsule. The acetabulum is clearly divisible into cartilaginous and non-cartilaginous regions; the former is horse-shoe shaped and encloses the latter, which is occupied by a pad of fat. Immediately around this pad the ligamentum teres, which here is flattened and spread out, acquires an attachment to the crescentic margin separating the articular from the non-articular area of the acetabulum. The depth of the acetabulum is consider-

ably increased by a fibro-cartilaginous ring, which is attached to the rim of the cavity where this is formed by the cartilaginous-covered surface, but bridges over the cotyloid notch, or interval between the ends of the horse-shoe, forming a foramen through which pass the articular branch of the obturator nerve and a branch of the obturator artery. These structures then run in the ligamentum teres to the head of the femur. The fibro-cartilaginous ring is known as the *cotyloid ligament* [labrum glenoidale], and immediately to its outer side the capsule is attached (see Fig. 168, Cot.).

Identify the structures round the joint, and particularly notice the *ilio-psoas* passing in front of the capsule on its way to be inserted into the lesser trochanter and the bone below.

THE LEG

The leg, or that portion of the lower limb extending from the knee to the ankle, is conveniently divided into four parallel and vertical regions, viz. the internal surface of the tibia, the anterior tibio-fibular compartment, the peroneal or fibular region, and the posterior tibio-fibular compartment.

The internal surface of the tibia is entirely subcutaneous except in its upper fourth, where the flat tendons of the sartorius, gracilis, and semi-tendinosus are inserted into it. Make an incision along the anterior border of the tibia from the knee to the ankle. From the lower end of this incision carry the knife horizontally inwards and outwards to the internal and external malleoli. Reflect the skin inwards, thereby exposing the superficial fascia covering the internal surface of the tibia. Lying in this fascia, just behind the inner border of the tibia, are two cutaneous nerves and a large vein. The vein will be at once noted; it is the *internal* or *long saphenous*, already studied in the dissection of the thigh. Very close to it lies the larger of the two nerves—the *internal saphenous*—while still farther back, in the upper part of the dissection, the *posterior division of*

the internal cutaneous nerve will be seen. The tributaries of the vein and the branches of the nerves should be followed as far as possible. The veins are particularly important in this region on account of their tendency to become varicose. It is a good exercise to slit open the whole length of the long saphenous vein and to examine its interior for valves. These are numerous, but not nearly so numerous as is often stated.

The superficial fascia may next be cleared away from the internal surface of the tibia, preserving, however, the nerves and vein. The three tendons inserted into this surface will now be exposed. They should be carefully cleaned and traced to their insertions. In doing this it will be seen that the tendons are more or less united, and at the same time they are separated from each other and from the underlying internal lateral ligament by a well-marked bursa. The *sartorius* is inserted most anteriorly, the *gracilis* and *semi-tendinosus* behind, the former above the latter. On turning the tendons forward a good view will be obtained of the internal lateral ligament of the knee, its superficial surface smooth and glistening from the overlying bursa. At the posterior border of the ligament, partly continuous with it, partly passing deep to it, is the rounded tendon of insertion of the semi-membranosus muscle.

The Anterior Tibio-fibular Compartment

To expose this compartment, the skin must be reflected outwards from the anterior border of the tibia. In the superficial fascia two nerves should be found, a cutaneous branch to the upper part from the external popliteal nerve, and the cutaneous division of the *musculo-cutaneous nerve* [n. peronæus superficialis] to the lower part. The former branch should be found by incising the fascia along a line forwards and downwards from the neck of the fibula, the latter nerve at the junction of the middle and lower thirds

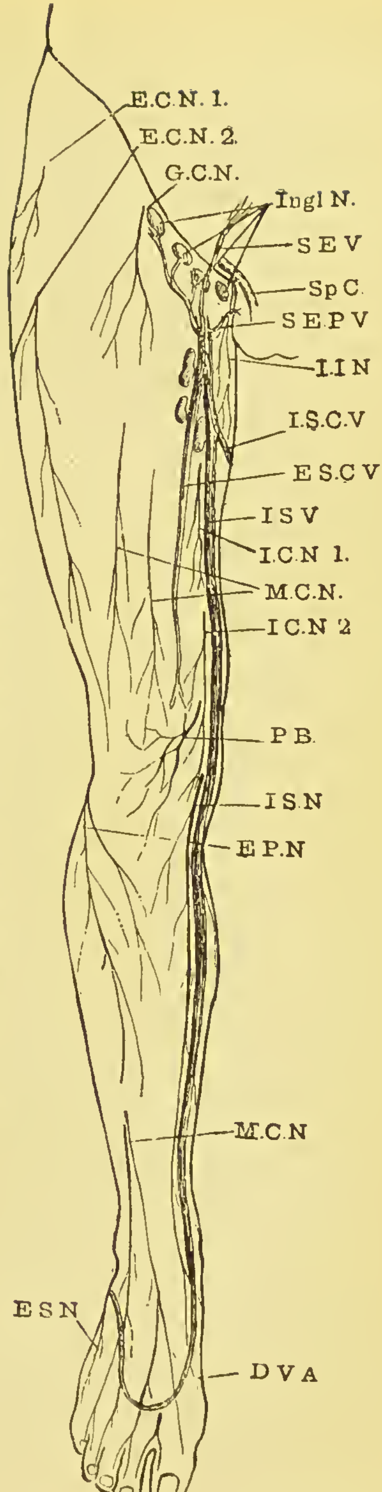


FIG. 169.—SUPERFICIAL STRUCTURES IN FRONT OF LOWER LIMB.

E.C.N. 1, *E.C.N.* 2. Anterior Division of External Cutaneous Nerve. *G.C.N.* Genito-crural Nerve. *Ingl.N.* Inguinal Group of Lymph Nodes with Superficial Circumflex Iliac Vessels supplying them. *S.E.V.* Superficial Epigastric Vessels. *Sp.C.* Spermatic Cord. *S.E.P.V.* Superficial External Pudic Vessels. *I.I.N.* Ilio-inguinal Nerve. *I.S.C.V.* Posterior Saphenous (Internal Saphenous Collateral) Vein. *E.S.C.V.* Anterior Saphenous (External Saphenous Collateral) Vein. *I.S.V.* Internal Saphenous Vein. *I.C.N.* 1, *I.C.N.* 2. Internal Cutaneous Nerve. *M.C.N.* Middle Cutaneous Nerve. *P.B.* Patellar Branch of Long Saphenous Nerve. *I.S.N.* Long (Internal) Saphenous Nerve.[1] *E.P.N.* Cutaneous Branches of External Popliteal Nerve. *M.C.N.* Musculo-cutaneous Nerve. *D.V.A.* Dorsal Venous Arch. *E.S.N.* Short (External) Saphenous Nerve.

[1] In most cases this nerve lies behind the vein instead of in front as it did in this specimen.

of the leg, in the pre-peroneal groove. From this point, where it pierces the deep fascia, it courses downwards and inwards. The superficial fascia may now be removed, while carefully preserving the nerves. The deep fascia will be noticed as a very strong fibrous covering, through which the muscles of the compartment can be seen, the positions of the intermuscular septa being indicated by white lines. In the upper part the deep fascia may be seen to include a number of fibres derived from the tendon of the biceps, while the lower part has incorporated in it a number of transverse fibres, to which the name of *anterior annular ligament* has been given. These fibres form two distinct bundles, one above and the other below the line of the ankle-joint. Of these the lower, the upper edge of which alone can be seen at present, is usually the better marked, and will be examined in the dissection of the dorsum of the foot. The deep fascia must now be removed, but in doing so it is as well to begin from below and retain the bands of the anterior annular ligament, for they keep the underlying structures, even after dissection, in their proper position. Special care must be taken not to cut away the upper part of the anterior annular ligament [lig. transversum cruris]; it runs, nearly horizontally across, between the lower ends of the tibia and fibula, and is about an inch in breadth. In stripping off the deep fascia of the upper part of the leg, it will be noticed that the muscles deep to it take a considerable part of their origin from it. The muscles in the upper part of the compartment are almost inseparable, but after the muscular bellies have passed into rounded tendons, the triple nature of the mass becomes manifest. It is advisable to pick up the tendons immediately above the ankle-joint and to trace them upwards to their respective muscular portion. The tendons from within outwards are those of the *Tibialis anticus, Extensor proprius hallucis*, and *Extensor longus digitorum* muscles. Of these three muscles the first and last take origin as high as the external tuberosity of the tibia, whereas the extensor longus

hallucis does not reach higher than the junction of the upper fourth with the lower three-fourths of the leg. In cleaning these tendons a quantity of loose moist tissue will be removed. This forms the synovial sheaths lubricating them.

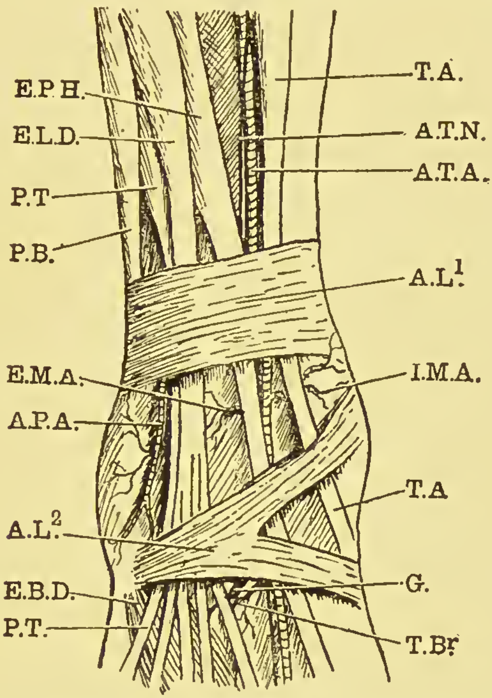


Fig. 170.—Dissection of the Front of the Right Ankle.

E.P.H. Extensor Proprius Hallucis. *E.L.D.* Extensor Longus Digitorum. *P.T.* Peroneus Tertius. *P.B.* Peroneus Brevis. *E.M.A.* External Malleolar Artery. *A.P.A.* Anterior Peroneal Artery. *A.L.*^{1} Upper Part of Anterior Annular Ligament. *A.L.*^{2} Lower Part of Anterior Annular Ligament. *E.B.D.* Extensor Brevis Digitorum. *T.A.* Tibialis Anticus. *A.T.N.* Anterior Tibial Nerve. *A.T.A.* Anterior Tibial Artery. *I.M.A.* Internal Malleolar Artery. *G.* Ganglion on Nerve to Extensor Brevis Digitorum. *T.B^r.* Tarsal Branch of Dorsalis Pedis Artery.

Injections of these sheaths with coloured gelatin show that they extend up as far as the place where the flesh joins the tendon. On looking into the interval between the tibialis anticus and extensor longus hallucis, the *anterior tibial nerve*

[n. peronæus profundus] and *vessels* will be seen. These vessels and nerve should be carefully cleaned and their branches followed. In doing this the interosseous membrane, which passes between the tibia and fibula, will come into view.

The *Tibialis Anticus* muscle arises from the external tuberosity and outer surface of the tibia in its upper two-thirds. Its tendon of insertion passes deep to the two bands of the anterior annular ligament, and will be traced later to its destination. It is supplied by a branch of the anterior tibial nerve, which enters the outer surface of the muscle near its middle. The vascular supply of the muscle is derived from the anterior tibial artery. One branch from this artery is more constant in position than are the others. It arises immediately after the artery has appeared through the interosseus membrane, and runs upwards into the substance of the muscle, being known as the *Anterior Tibial Recurrent* artery. Near its termination it is accompanied by a branch given off from the external popliteal nerve immediately before it divides, and known as the *recurrent articular branch*. It helps to supply the tibialis anticus muscle, and also furnishes fine twigs to the superior tibio-fibular and knee-joints.

The *Extensor longus digitorum muscle* arises from the upper three-fourths of the anterior surface of the fibula; its tendon passes downwards deep to the anterior annular ligament. Its nerve and arterial supply are derived from the anterior tibial nerve and artery. To its outer side in the lower part, and indistinctly separable from it, is the *peroneus tertius muscle*, which takes origin from the lower fourth of the anterior surface of the fibula. Its nerve and blood supply are derived from the same source as are those of the extensor longus digitorum, of which it is an extra insertion only found in man. To the inner side of this latter muscle, between it and the tibialis anticus, lies the *extensor proprius hallucis muscle*, which arises from the middle two-fourths of the anterior surface of the fibula. The nerve and arteries supply-

ing it are derived from the anterior tibial; they enter the muscle on its inner surface.

The *Anterior Tibial Artery* is the main artery of the anterior tibio-fibular compartment. It runs down, lying at

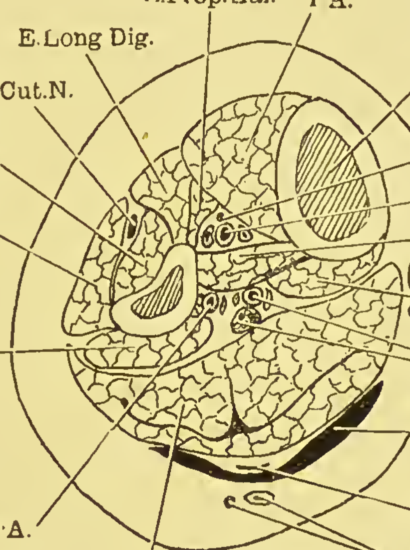


FIG. 171.—TRANSVERSE SECTION THROUGH THE LEFT LEG AT THE JUNCTION OF ITS MIDDLE AND LOWER THIRDS. (TRACED WITH A DIOPTOGRAPH.)

Tib. Tibia. *A.Tib.N.* Anterior Tibial Nerve. *A.Tib.V.* Anterior Tibial Vessels. *Tib.Post.* Tibialis Posticus. *L.Saph.V. & N.* Long Saphenous Vein and Nerve. *F.Long.Dig.* Flexor Longus Digitorum *P.Tib.A. & N.* Posterior Tibial Artery and Nerve. *Gast.* Gastrocnemius. *Plant.* Plantaris. *E.Saph.V. & N.* External Saphenous Vein and Nerve. *Sol.* Soleus. *Per[l].A.* Peroneal Artery. *F.L.Hal.* Flexor Longus Hallucis. *P.Long.* Peroneus Longus. *P.Brev.* Peroneus Brevis. *Musc.Cut.N.* Musculo-cutaneous Nerve. *E.Long.Dig.* Extensor Longus Digitorum. *E.Prop.Hal.* Extensor Proprius Hallucis. *T.A.* Tibialis Anticus.

first upon the interosseous membrane, next upon the anterior surface of the lower end of the tibia, and lastly, on the anterior ligament of the ankle-joint. It lies between the tibialis anticus and extensor longus digitorum above, then

between the tibialis anticus and extensor proprius hallucis, and finally, between the extensor longus digitorum and extensor proprius hallucis, being crossed, just above its termination, by the tendon of the extensor proprius hallucis. In addition to the *anterior tibial recurrent* and *muscular* branches, it gives off *internal* and *external malleolar* branches, which ramify over the internal and external malleoli respectively. In ligaturing this artery it is well to remember that in almost its whole course it lies close to the tibialis anticus, and that the outer edge of this muscle is the guide to the artery (see Fig. 171).

The *Anterior Tibial Nerve* [n. peronæus profundus] appears in the compartment by piercing the extensor longus digitorum just below the external tuberosity of the tibia. It lies first to the outer side of the anterior tibial artery, then in front of the artery, and lastly, to the outer side again. It leaves the compartment by passing downwards deep to the anterior annular ligament. It supplies the four muscles in the anterior tibio-fibular region. If now the extensor longus digitorum and the peroneus tertius be turned outwards, a small artery will often be seen piercing the interosseous membrane a little above the ankle-joint, and descending under cover of the latter muscle; it is the *anterior peroneal* artery, and may be traced downwards to the region of the external malleolus, where it anastomoses with the external malleolar artery already mentioned. It will be readily understood that if the anterior peroneal artery is large, the external malleolar is likely to be small or absent, and *vice versa*.

Peroneal Compartment

The transverse incisions already made at the level of the knee and ankle should now be carried round the outer surface of the leg. In the superficial fascia thus exposed branches from nerves already seen in part will be found; in the upper half, twigs from the cutaneous branch of the

external popliteal nerve to the upper, outer, and anterior part of the leg; in the lower half, from the musculo-cutaneous nerve. A few small veins may also be seen passing backwards into the posterior compartment. If the superficial fascia be next cleared away, the strong deep fascia will become apparent marked by two white vertical lines corresponding to intermuscular septa — the anterior peroneal septum [s. intermusculare anterius], between the anterior tibio-fibular compartment and the peroneal; the posterior peroneal septum [s. intermusculare posterius] between the posterior tibio-fibular compartment and the peroneal. It is at the junction of the middle and lower thirds of the anterior peroneal septum that the musculo-cutaneous nerve pierces the deep fascia. The deep fascia should be now incised vertically, midway between the two septa, and turned forward and backward. In the compartment thus opened are two muscles only clearly separable from each other after the muscular bellies have passed into tendon, the *peroneus longus* [m. peronæus longus] and *peroneus brevis.* The easiest way of separating them is to begin with the tendons and then to trace the muscles upwards. The tendons lie close together, that of the peroneus brevis lying directly in contact with the bone, deep to the tendon of the peroneus longus. The *peroneus longus* will be seen to arise from the upper two-thirds of the external surface of the fibula, the *peroneus brevis* from the lower two-thirds. There is consequently an overlap in the middle third, the peroneus brevis lying anterior to the peroneus longus. In addition to their origin from bone, both muscles arise from the septa between which they lie. The large *external popliteal nerve* [n. peronæus communis] enters the upper part of the compartment, winding round the neck of the fibula under cover of the peroneus longus muscle, in which position it divides into its two terminal divisions, the anterior tibial [n. peronæus profundus] which pierces the anterior peroneal septum high up and so enters the anterior tibio-fibular compartment, and the

musculo-cutaneous nerve [n. peronæus superficialis] which descends upon the outer surface of the fibula under cover of the peroneus longus to the interval between the two peronei muscles, and then becomes cutaneous immediately behind the anterior peroneal septum at the junction of the middle and lower thirds of the leg. In its course the musculo-cutaneous nerve furnishes twigs to the two peronei muscles between which it lies.

Posterior Tibio-fibular Compartment

The skin may now be entirely removed from the leg, but should be preserved, as it furnishes a very useful covering in which to wrap the part in the intervals of dissection. In the upper half of the region search should be made in the superficial fascia for a number of small twigs of the small sciatic nerve, while in the lower half a relatively large nerve—the *external saphenous*—will be found descending in or near the median line. This nerve is formed by the union of two others, which usually pierce the deep fascia separately, the *ramus communicans tibialis* and the *ramus communicans fibularis*. Lying with these nerves, and forming in most cases a very prominent object, is the *external saphenous vein*, which passes upwards along a line from the back of the external malleolus to the middle of the popliteal space, where it has already been seen terminating in the popliteal vein. The internal saphenous vein also lies for a time in this region, passing upwards just behind the internal border of the tibia. In the superficial fascia, in close relation to the vein, is the internal saphenous nerve, while a little posterior in the upper part of the leg is the posterior division of the internal cutaneous nerve. The deep fascia should now be removed. Make a median vertical incision and turn it inwards and outwards. The two fleshy bellies of the *gastrocnemius* will now be fully exposed as they pass down to form the superficial part of a large tendon, the *tendo*

Achillis [t. ealeaneus], whieh is inserted into the baek of the os ealeis. If the origin of the two bellies be observed, it will be seen that at the lateral border of eaeh a strong rounded tendinous part is present, the outer of which takes origin from a distinet pit on the outer side of the external eondyle of the femur, while the inner belly arises from the popliteal surfaee of the femur between the eondyle and the adduetor tuberele, and moreover reaehes to a lower level in the ealf.

The branches from the internal popliteal nerve to these museular bellies must next be identified. They enter the deep surface near the origin of the musele. Immediately to the inner side of the outer belly of the gastroenemius a small fusiform muscular belly may be seen arising from the external condyle above the origin of the outer belly and continued into a long narrow tendon. This musele is the *plantaris*. It is supplied by a twig from the internal popliteal nerve. In many eases no traee of the musele is to be found. The handle of the sealpel should now be passed deep to the muscular bellies of the gastrocnemius in order to separate them from underlying struetures, after which the muscle should be divided transversely and turned upwards and downwards. A view will now be obtained of the tendon of the plantaris if it be present. It passes obliquely downwards and inwards from its origin. Deep to the gastrocnemius and plantaris lies the popliteus and the large museular mass of the soleus, the upper border of which will be seen to form a more or less free tendinous areh, which passes from tibia to fibula, bridging over the posterior tibial vessels and nerve.

The *popliteus* is a triangular musele the apex of which forms the tendon of origin, and, since this is intra-artieular, it will be seen when the knee is disseeted. The wider fleshy part is inserted into the posterior surface of the tibia above the oblique line. The peculiarity of its nerve, whieh hooks round its lower border, has been notieed already, and the

muscle may now be cut through in order that the nerve may be seen entering its deep surface.

The *soleus* arises from the oblique line on the posterior surface of the tibia and the inner border of the shaft for two inches below the oblique line, from the fibrous arch above-mentioned and from the head and upper third of the posterior surface of the fibula. From this extensive horse-shoe-shaped origin the muscle passes downwards, forming a strong tendon, which, blending with that of the gastrocnemius muscle, forms by far the greater part of the tendo Achillis. The soleus is supplied on its deep surface by twigs from the internal popliteal and posterior tibial nerves; the latter are, however, not to be seen at present. The soleus should be divided transversely just above the point where its tendon fuses with that of the gastrocnemius. The tendo Achillis can now be turned completely downwards. The portion of the soleus still left *in situ* should next be divided by a vertical incision midway between its inner and outer borders, taking great care not to carry the incision beyond the deep surface of the muscle, which is lined by a shining aponeurosis. The two halves may now be turned aside, when a good view will be obtained of its origin as well as of the posterior tibial vessels and nerve with twigs from them to the soleus. These vessels and nerve should be carefully cleaned and their branches to adjoining parts followed. In this procedure the deep flexor muscles of the leg will come under observation. These muscles are three in number, the flexor longus hallucis on the outer side, the flexor longus digitorum on the inner side, the tibialis posticus between and to some extent deep to the other two. The *posterior tibial nerve* [n. interosseus cruris] will be seen crossing the *posterior tibial artery* from within outwards, while the artery lies, from above downwards, on the tibialis posticus, the flexor longus digitorum, and the posterior surface of the lower extremity of the tibia. If the artery be traced to its origin it will be seen to continue the line of the popliteal artery which

bifurcates at the lower border of the popliteus into the anterior and posterior tibial arteries. The former artery will be seen to pass forward through the interosseous membrane.

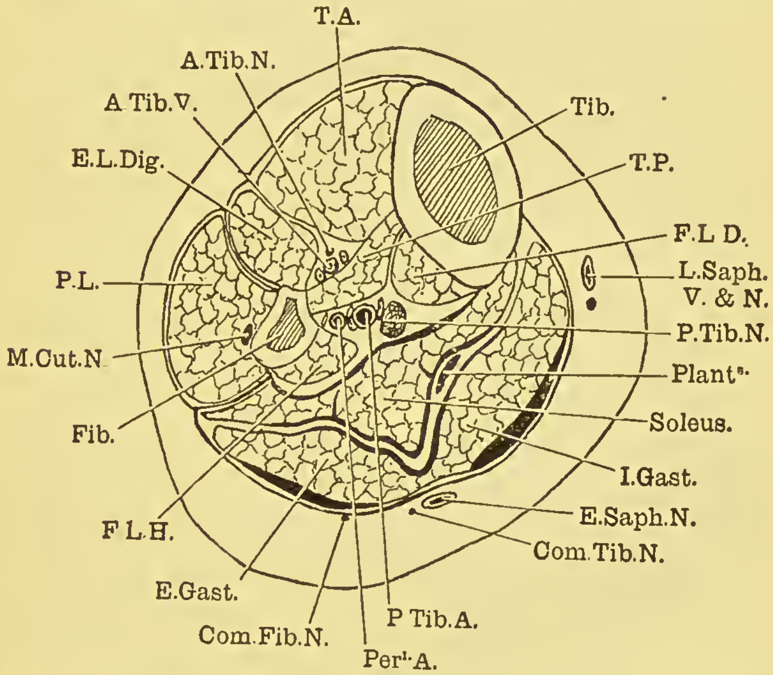


FIG. 172.—TRANSVERSE SECTION THROUGH THE LEFT LEG AT THE JUNCTION OF ITS UPPER AND MIDDLE THIRDS. (TRACED WITH A DIOPTOGRAPH.)

Tib. Tibia. *T.P.* Tibialis Posticus. *F.L.D.* Flexor Longus Digitorum. *L.Saph.V. & N.* Long Saphenous Vein and Nerve. *P.Tib.N.* Posterior Tibial Nerve. *Plant^s.* Plantaris. *I.Gast.* Inner Head of Gastrocnemius. *E.Gast.* Outer Head of Gastrocnemius. *E.Saph.N.* External Saphenous Vein. *Com.Tib.N.* Communicans Tibialis Nerve. *P.Tib.A.* Posterior Tibial Artery. *Per^l.A.* Peroneal Artery. *Com.Fib.N.* Communicans Fibularis Nerve. *F.L.H.* Flexor Longus Hallucis. *Fib.* Fibula. *M.Cut.N.* Musculo-cutaneous Nerve. *P.L.* Peroneus Longus. *E.L.Dig.* Extensor Longus Digitorum. *A.Tib.V.* Anterior Tibial Vessels. *A.Tib.N.* Anterior Tibial Nerve. *T.A.* Tibialis Anticus.

Before it leaves the posterior tibio-fibular compartment, however, it gives off two small branches, one of which runs outwards deep to the soleus, the *superior fibular,* while the

other runs upwards under cover of the popliteus, the *posterior tibial recurrent.* From the posterior tibial artery, in addition to small muscular and cutaneous twigs of

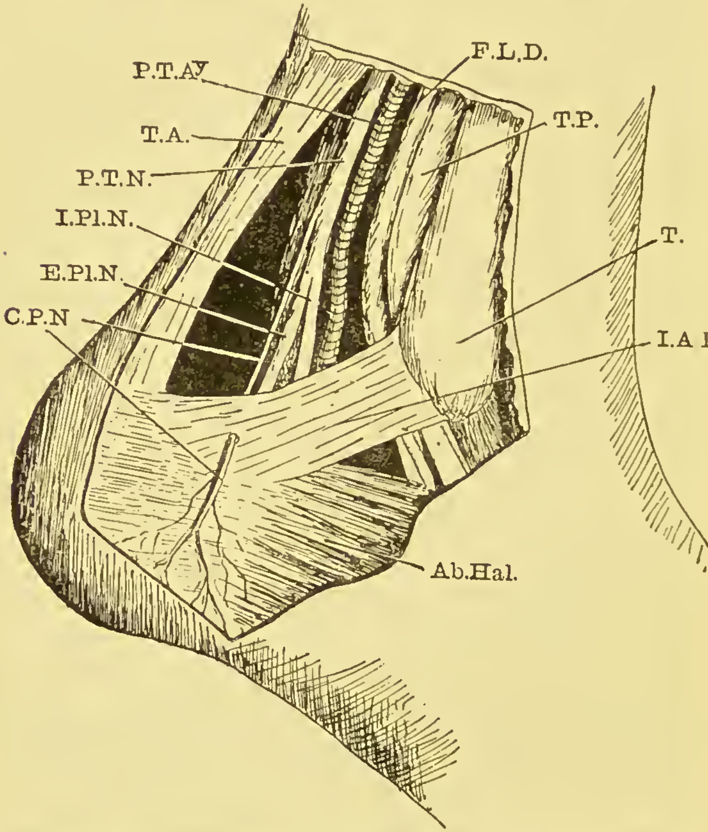


FIG. 173.—DISSECTION OF INNER SIDE OF LEFT ANKLE.

F.L.D. Flexor Longus Digitorum. *T.P.* Tibialis Posticus. *T.* Internal Malleolus. *I.A.L.* Internal Annular Ligament. *Ab.Hal.* Abductor Hallucis. *C.P.N.* Calcaneo-plantar Cutaneous Nerve. *E.Pl.N.* External Plantar Nerve. *I.Pl.N.* Internal Plantar Nerve. *P.T.N.* Posterior Tibial Nerve. *P.T.Aʸ.* Posterior Tibial Artery. *T.A.* Tendo Achillis.

inconstant position, three considerable branches arise; the highest and largest springs from the main trunk about an inch below its origin—*the peroneal artery;* it passes downwards and outwards superficial to the tibialis posticus, dis-

appearing in the muscular substance of the flexor longus hallucis. The second branch is the *nutrient artery to the tibia,* entering the large nutrient foramen of that bone a

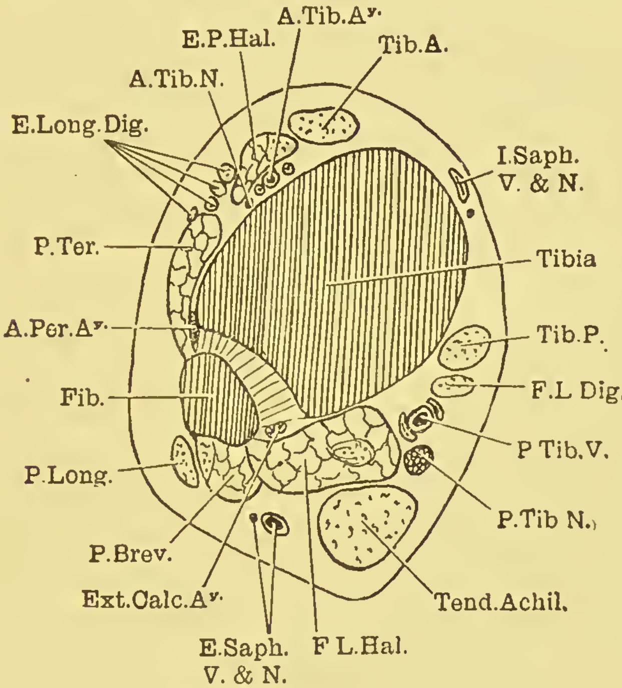


FIG. 174.—TRANSVERSE SECTION THROUGH THE LEFT LEG A LITTLE ABOVE THE ANKLE-JOINT. (TRACED WITH A DIOPTOGRAPH.)

I.Saph.V. & N. Internal Saphenous Vein and Nerve. *Tib.P.* Tibialis Posticus. *F.L.Dig.* Flexor Longus Digitorum. *P.Tib.V.* Posterior Tibial Vessels. *P.Tib.N.* Posterior Tibial Nerve. *Tend.Achil.* Tendo Achillis. *F.L.Hal.* Flexor Longus Hallucis. *E.Saph.V. & N.* External Saphenous Vein and Nerve. *Ext.Calc.A^{y}.* External Calcaneal Artery. *P.Brev.* Peroneus Brevis. *P.Long.* Peroneus Longus. *Fib.* Fibula. *A.Per.A^{y}.* Anterior Peroneal Artery. *P.Ter.* Peroneus Tertius. *E.Long. Dig.* Extensor Longus Digitorum. *A.Tib.N.* Anterior Tibial Nerve. *E.P.Hal.* Extensor Proprius Hallucis. *A.Tib.A^{y}.* Anterior Tibial Artery. *Tib.A.* Tibialis Anticus.

short distance below the oblique line from which the soleus arises. The third branch runs transversely between the peroneal and posterior tibial arteries a little above the ankle-

joint; it is known as the *communicating artery*, but is not always present.

The *flexor longus hallucis* muscle arises from the lower two-thirds of the posterior surface of the fibula. The *flexor longus digitorum* muscle arises from the posterior surface of the tibia, below the oblique line and internal to the vertical line. The *tibialis posticus* arises from the internal surface of the fibula and from the posterior surface of the tibia, external to the vertical line, as well as from the posterior surface of the interosseous membrane. The insertion of these muscles will be seen later.

It should be noticed that the flexor longus hallucis is fleshy nearly as far as the ankle; this fact serves at a glance to distinguish it from the tibialis posticus and flexor longus digitorum, which have comparatively long tendons (Fig. 174).

Behind the inner malleolus the position of the structures is very important, on account of tenotomy operations. The tibialis posticus is the innermost tendon and lies nearest the bone. The flexor longus digitorum lies posterior and a little external to it. Then come the posterior tibial vessels, the nerve lying to their outer side; while still more external is the tendon of the flexor longus hallucis.

All these three tendons have synovial sheaths, which are continued up as far as the junction of the tendon with the flesh.

The muscular mass of the flexor longus hallucis should now be carefully divided near its inner border by a vertical incision, thereby exposing the *Peroneal Artery* [a. peronæa], which descends in an osseo-muscular tunnel between the muscle and the shaft of the fibula. Two inches or so above the level of the ankle-joint a large branch usually leaves the peroneal artery, and, piercing the interosseous membrane, enters the anterior tibio-fibular compartment, where, as the anterior peroneal artery, it has already been studied.

The rest of the peroneal artery becomes the *external calcaneal* (see Fig. 174).

THE FOOT

THE DORSUM OF THE FOOT

The skin should now be reflected from the dorsum of the foot. Make a longitudinal incision in the median line and a transverse incision at the root of the toes. The flaps can then be reflected inward and outward. Median incisions may also be made through the skin on the dorsum of the toes and the skin similarly treated. In the superficial fascia now exposed search should be made for the subcutaneous vessels and nerves. The most obvious vessels are the veins, which, forming a distinct arch known as the *dorsal venous arch*, are continued upwards on the inner and outer aspects of the dorsum as the internal and external saphenous veins respectively. The former passes in front of the internal malleolus, the latter behind the external malleolus. In close relationship to these two veins will be found corresponding nerves—the *internal* and *external saphenous*. These two nerves should now be traced to their termination. The former of the two nerves will be found to end in most cases about half-way along the inner border of the foot, branches being given off on either side to supply the adjacent portions of skin. The external saphenous nerve, on the other hand, can be traced to the outer border of the little toe, while not infrequently it may be seen to supply in addition the adjacent sides of the 4th and 5th toes (see Fig. 175).

When this is the case, it will always be found that the communicans fibularis component of the external saphenous (see p. 360) is particularly large; the explanation being that fibres which usually run with the musculo-cutaneous branch of the external popliteal nerve accompany in these cases the external saphenous *viâ* the communicans fibularis.

Midway between the two saphenous nerves lies another large cutaneous nerve already met in the dissection of the

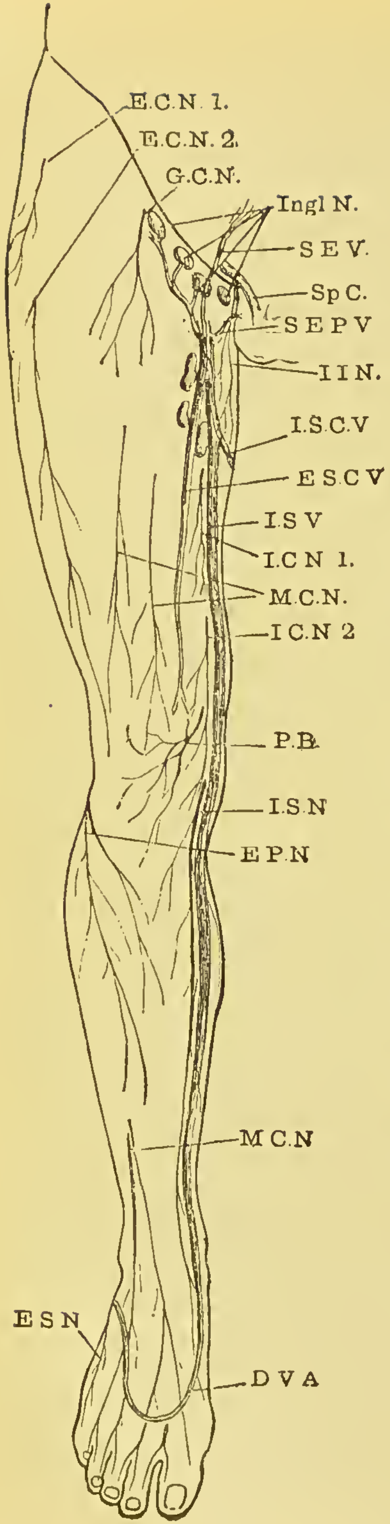


Fig. 175.—Superficial Structures in Front of Lower Limb.

E.C.N. 1, *E.C.N.* 2. Anterior Division of External Cutaneous Nerve. *G.C.N.* Genito-crural Nerve. *Ingl.N.* Inguinal Group of Lymph Nodes with Superficial Circumflex Iliac Vessels supplying them. *S.E.V.* Superficial Epigastric Vessels. *Sp.C.* Spermatic Cord. *S.E.P.V.* Superficial External Pudic Vessels. *I.I.N.* Ilio-inguinal Nerve. *I.S.C.V.* Posterior Saphenous (Internal Saphenous Collateral) Vein. *E.S.C.V.* Anterior Saphenous (External Saphenous Collateral) Vein. *I.S.V.* Internal Saphenous Vein. *I.C.N.* 1, *I.C.N.* 2. Internal Cutaneous Nerve. *M.C.N.* Middle Cutaneous Nerve. *P.B.* Patellar Branch of Long Saphenous Nerve. *I.S.N.* Long (Internal) Saphenous Nerve.[1] *E.P.N.* Cutaneous Branches of External Popliteal Nerve. *M.C.N.* Musculo-cutaneous Nerve. *D.V.A.* Dorsal Venous Arch. *E.S.N.* Short (External) Saphenous Nerve.

[1] This nerve is more often behind its vein.

peroneal compartment—the *musculo-cutaneous nerve.* As it passes downwards it also inclines somewhat inwards, supplying the inner side of the big toe and the adjacent sides of the 2nd, 3rd, 4th, and 5th toes. Lastly, in the interval between the 1st and 2nd metatarsal bones, the terminal branch of the *anterior tibial nerve* will be found. It is distributed to the adjacent sides of the 1st and 2nd toes.

In the dissection of these cutaneous structures the tendons of the extensor muscles of the leg will be exposed, and should be followed to the toes, their insertions being studied later.

While these tendons are being examined will be a good opportunity to dissect the lower or Y-shaped part of the *anterior annular ligament* [lig. cruciatum cruris]. The stalk of the Y is attached to the front of the upper surface of the calcaneum, and forms a loop which binds the extensor longus digitorum and peroneus tertius tendons down. To the distal end of the loop two stays are attached, which form the two limbs of the Y, the upper running to the internal malleolus, the lower to the inner part of the plantar fascia. The extensor proprius hallucis passes deep to both of these, but the tibialis anticus often splits the upper limb of the Y, and has part superficial and part deep to it (see Fig. 176).

Deep to these tendons will be seen the muscular belly and tendons of the *extensor brevis digitorum,* which arises from the front part of the superior surface of the os calcis and from the outer extremity of the Y-shaped anterior annular ligament. From this origin the muscle passes forwards and inwards, dividing into four tendons, which are traceable to the four inner toes. In cleaning this muscle its nerve of supply from the anterior tibial should be sought, and on it a gangliform enlargement may be seen. The full course of the *anterior tibial nerve* in the foot can now be displayed. The nerve lies immediately to the outer side of the dorsalis pedis artery, furnishing, in addition to the

terminal branch and the twig to the extensor brevis digitorum, a number of fine filaments to adjacent articulations, while occasionally small branches can be traced to the 1st

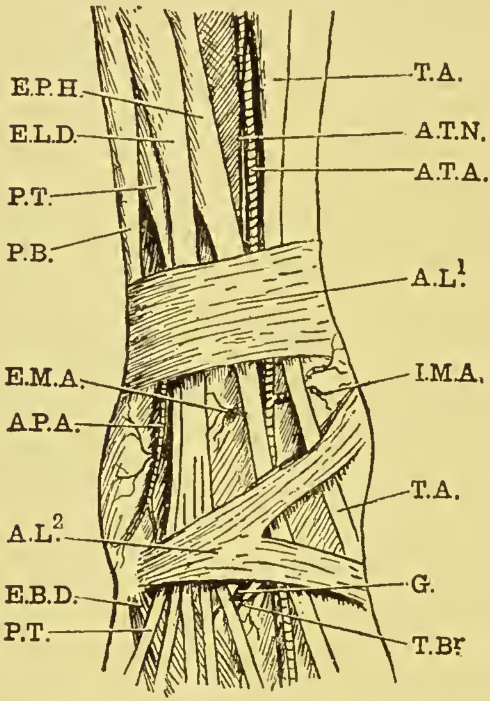


FIG. 176.—DISSECTION OF THE FRONT OF THE RIGHT ANKLE.

E.P.H. Extensor Proprius Hallucis. *E.L.D.* Extensor Longus Digitorum. *P.T.* Peroneus Tertius. *P.B.* Peroneus Brevis. *E.M.A.* External Malleolar Artery. *A.P.A.* Anterior Peroneal Artery. *A.L.*[1] Upper Part of the Anterior Annular Ligament. *A.L.*[2] Lower Part of Anterior Annular Ligament. *E.B.D.* Extensor Brevis Digitorum. *T.A.* Tibialis Anticus. *A.T.N.* Anterior Tibial Nerve. *A.T.A.* Anterior Tibial Artery. *I.M.A.* Internal Malleolar Artery. *G.* Ganglion on Nerve to Extensor Brevis Digitorum. *T.Br.* Tarsal Branch of Dorsalis Pedis Artery.

and 2nd dorsal interosseous muscles. The *arteria dorsalis pedis* is the continuation on to the dorsum of the foot of the anterior tibial artery of the leg. It lies upon the astragalus and navicular, and then over the middle cuneiform bone, disappearing finally by dipping down between the 1st

and 2nd metatarsals, to reach the sole of the foot, where it helps to form the plantar arch. As it runs forward it gives off two branches, which pass almost transversely outwards, the *tarsal* [a. tarsea lateralis], at or near the level of the astragalo-navicular joint, and the *metatarsal*, near the line of the tarso-metatarsal joint. Just before the artery disappears, a third branch—the *first dorsal interosseus*—passes forwards in the first inter-metatarsal space. Similar arteries are found in the other interosseous spaces, the *2nd, 3rd,* and *4th dorsal interosseous arteries* [aa. digitales dorsales], branches of the metatarsal artery. These interosseous arteries lie in each case upon the dorsal interosseous muscles, to which they furnish a number of small arterial twigs.

The insertion of the extensor tendons should next be examined. The *tibialis anticus tendon* is inserted into the inner surface of the internal cuneiform and the adjacent part of the base of the 1st metatarsal bone. The *extensor proprius hallucis tendon* is inserted into the dorsal surface of the base of the distal phalanx of the big toe, while the innermost tendon of the *extensor brevis digitorum* is inserted separately into the base of the proximal phalanx of the same toe. The tendons of the *extensor longus digitorum* to the 2nd, 3rd, and 4th toes unite with the tendons of the extensor brevis digitorum to these toes in an expansion which lies over the proximal phalanx, but which, traced forwards, divides into a central and two lateral slips, the first of which is inserted into the base of the 2nd phalanx, while the two lateral slips reunite and gain insertion into the terminal phalanx. The tendon of the extensor longus digitorum to the 5th toe forms a similar expansion, from which similar slips proceed to their insertion. The tendon of the *peroneus tertius* should be next traced to its insertion into the dorsum of the base of the 5th metatarsal bone. Immediately to its outer side the tendon of the peroneus brevis will be seen to gain an insertion into the tuberosity of the same bone, and it is quite a common thing to find a fine tendon continued on

from it to the dorsal expansion of the extensor tendon to the 5th toe.

The Sole of the Foot

It is first necessary to fix the foot firmly, sole uppermost, and the best way to do this is to nail one or two of the toes to the upper surface of an upright block and allow the leg to hang down the side; this may also be secured by a lashing of string.

Next make a transverse incision just behind the clefts of the toes and, from its middle, another at right angles, which shall run back, along the centre of the sole, to the heel, and turn up to end at the place where the skin was reflected from the back of the calf. In making these incisions the enormous thickness of the skin of the sole, and especially of the heel, will be noticed (see Fig. 178).

Reflect these two flaps outwards and inwards and continue the reflexion until the limits of the exposed area on the dorsum are reached. This, of course, means that the flaps will be altogether removed—really an advantage, as they get very much in the way and are not much needed to keep the deeper parts moist, since the dissection is not a long one, and rapidly deepens layer by layer.

The *superficial fat* of the sole and heel will be found thick and very granular, owing to the fibrous septa which pass through it from the skin to the plantar fascia.

In working through this the knife should be stropped every few minutes. Close to the webs of the toes a slight bundle of transverse fibres is found—the *superficial transverse ligament* of the foot corresponding to the same structure in the hand.

On the inner side of the heel dissect carefully for a cutaneous nerve which often accompanies the internal calcaneal branch of the posterior tibial or external plantar artery, and so the artery, when injected, is a useful guide to it. This nerve supplies the skin of the heel and back part

of the sole, and is known as the *calcaneo-plantar cutaneous* [n. plantaris medialis] (see Fig. 173).

Farther forward in the sole the skin is supplied by twigs which appear in the intervals of the muscles of the first layer and are quite difficult to find in the granular fat at this stage.

As soon as the fat has been cleared away, the *plantar fascia* [aponeurosis plantaris] is exposed. This has three parts, the middle of which is very strong, while the two side-pieces are thin and unimportant. Clean the middle part carefully, and notice that it is attached posteriorly to the calcaneum, while anteriorly it divides into five slips, one for each of the toes, differing in this way from the similar structure in the hand which does not send a slip to the thumb.

Trace one of these slips into a toe, and notice that it divides and eventually reaches the sides of the proximal phalanx after allowing the flexor tendons to pass between the two divisions.

Just before the plantar fascia divides for the five toes, a transverse band of fibres prevents it splitting back any farther, and this is known as the *superficial transverse metatarsal ligament* [fasciculi transversi aponeurosis plantaris]. The intervals between the five slips are the places in which to look for the *digital branches of the plantar arteries and nerves.* Remember, in looking for them, that the nerves are superficial to the arteries and will be met with first.

Now clear away the thin external and internal parts of the deep plantar fascia in order to expose the muscles which lie deep to them. On the inner side is the abductor hallucis, and on the outer the abductor minimi digiti (see Fig. 177).

To see the attachments of the *abductor hallucis,* cut it across about its middle and turn the ends forward and back. It will be found rising from the internal annular ligament, from the inner of the two posterior tubercles of the calcaneum, and from the inner side of a strong fibrous septum

which lies between it and the flexor brevis digitorum, its neighbouring musele. Traeed forwards the tendon is inserted into the inner side of the base of the proximal phalanx of the big toe.

Be careful in refleeting the origin, because the two plantar arteries and nerves lie here on the inner side of the calcaneum, deep to the abduetor hallueis and between it and the aeeessorius. With eare the twig from the internal plantar nerve may be traeed into the deep surface of the abduetor hallueis.

The *abductor minimi digiti* [m. abduetor digiti quinti] is seen on the outer side of the foot, rising from both the inner and outer posterior tubereles of the calcaneum, as well as from the strong septum which lies between it and the flexor brevis digitorum. Its insertion may be traeed to the outer side of the base of the proximal phalanx of the little toe, while in its eourse it almost always gives some fibres to or reeeives some fibres from, an attaehment to the base of the fifth metatarsal bone. Little is gained by eutting this partieular musele, though it is a good working rule to see what lies on the deep side of every muscle in the body. Next divide the eentral portion of the deep plantar faseia a little way behind its point of division for the toes, and turn it baek as far as possible without tearing the fibres of the subjaeent *flexor brevis digitorum*, which rise from its deep surface, as well as from the two septa which separate them respeetively from the abduetor hallueis and abduetor minimi digiti. It will now be realised that the flexor brevis digitorum rises from the inside of a trough-like fibrous eompartment, the floor of which is the plantar faseia and the sides the two intermuscular septa; the trough widens in front as the musele widens, but narrows rapidly behind, so that the bony origin of the flexor brevis is a very small one from the internal posterior tubercle of the ealeaneum. As the muscle runs forward it will be found to divide into four slips, one for eaeh of the four outer toes. Each of these

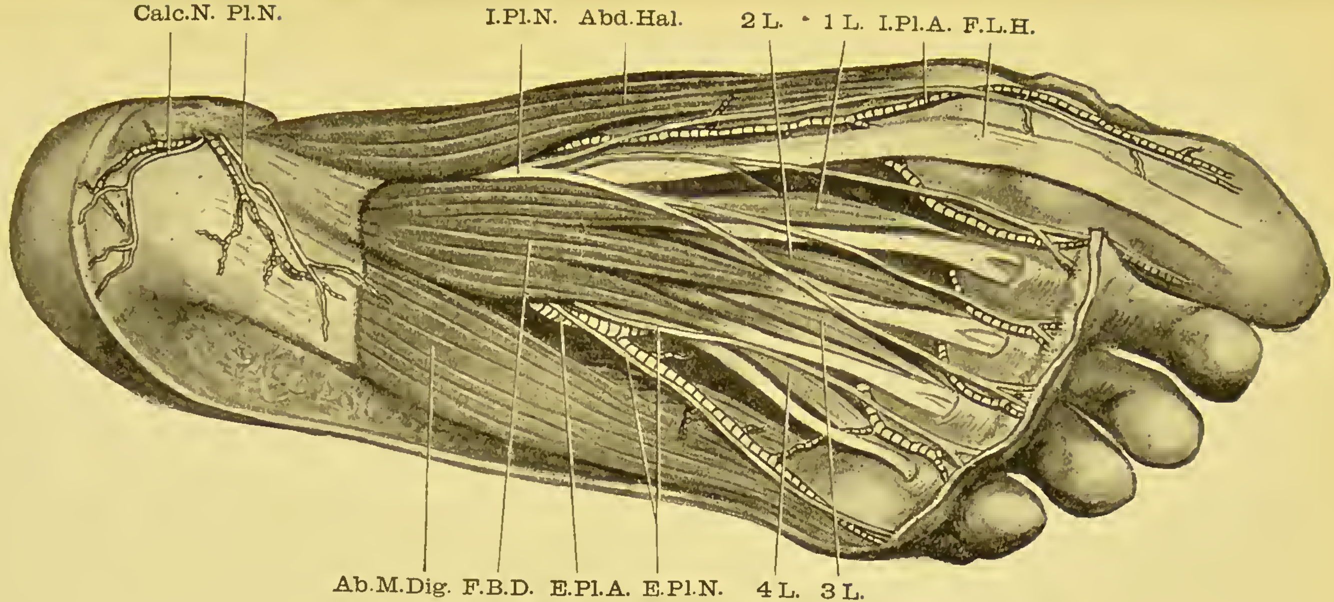


FIG. 177.—SUPERFICIAL DISSECTION OF SOLE.

F.L.H. Flexor Longus Hallucis. *I.Pl.A.* Internal Plantar Artery. 1, 2. 3, and 4 *L.* The four Lumbrical Muscles. *Abd.Hal.* Abductor Hallucis. *I.Pl.N.* Internal Plantar Nerve. *Pl.N.* Plantar Branch of Calcaneo-plantar Cutaneous Nerve. *Calc.N.* Calcaneal Branch of Calcaneo-plantar Cutaneous Nerve. *Ab.Min.Dig.* Abductor Minimi Digiti. *F.B.D.* Flexor Brevis Digitorum. *E.Pl.A.* External Plantar Artery. *E.Pl.N.* Superficial Division of External Plantar Nerve.

slips behaves in exactly the same way as the flexor sublimis digitorum tendons in the hand, dividing and wrapping round each side of the tendons of the flexor longus digitorum, joining again deep to those tendons and dividing once more to be inserted into the sides of the middle phalanges. As in the hand, the insertion of the muscle can only be seen when the fibrous *theca* or *digital sheath*, which contains the tendons, is laid open. Cut the muscle across and reflect it towards its origin, looking out carefully for a branch of the internal plantar nerve, which enters its deep surface.

These three muscles, the abductor hallucis, flexor brevis digitorum, and abductor minimi digiti form what is known as the first layer of the sole. The vessels and nerves should now be attended to, and it will probably be wise to follow the nerves first since they are of greater importance, while the arteries, owing to their injection, are not likely to be cut away.

The posterior tibial nerve was seen dividing at a higher level than the artery, as is the general rule with nerves, into the internal and external plantar.

At first these two nerves run downwards and forwards on the inner side of the calcaneum between the origins of the abductor hallucis and accessorius; here each artery often lies below its own nerve, the internal plantar nerve being highest, then the internal plantar artery, then the external plantar nerve, while the external plantar artery is the lowest of all, as a rule (see Fig. 178).

Follow the *internal plantar nerve* [n. plantaris medialis], which is rather the larger of the two, forward along the interval between the abductor hallucis and flexor brevis digitorum muscles, and notice the branches it gives off to each of these; some *plantar cutaneous twigs*, too, should be looked for between the two muscles. About the middle of the foot the whole nerve becomes superficial in the same interval, and divides into four digital branches, the innermost of which may be traced to the inner side of the big toe,

giving off a branch to the flexor brevis hallucis. The second digital nerve divides for the cleft between the first and second toes, and should be carefully dissected, because it

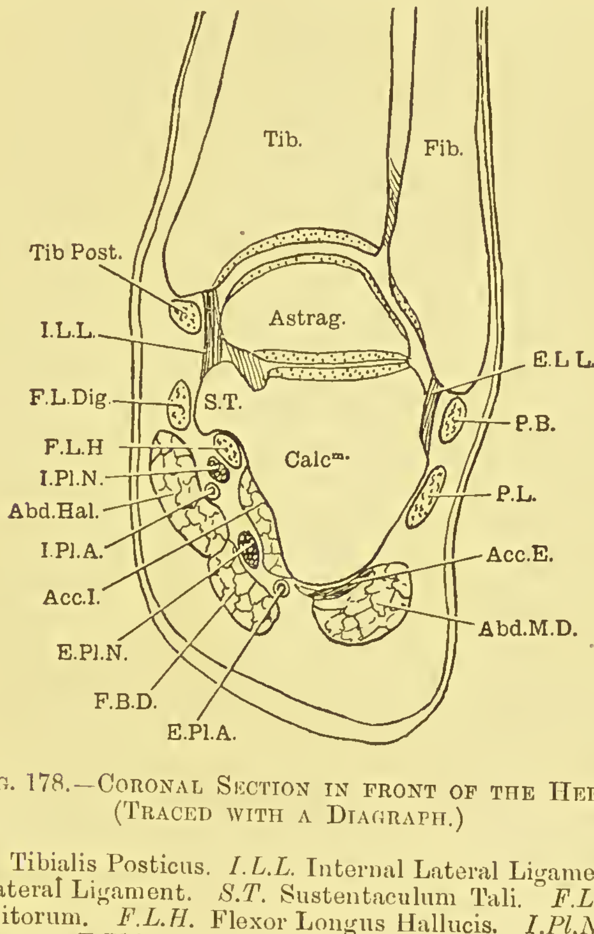


Fig. 178.—Coronal Section in front of the Heel. (Traced with a Diagraph.)

Tib.Post. Tibialis Posticus. *I.L.L.* Internal Lateral Ligament. *E.L.L.* External Lateral Ligament. *S.T.* Sustentaculum Tali. *F.L.D.* Flexor Longus Digitorum. *F.L.H.* Flexor Longus Hallucis. *I.Pl.N.* Internal Plantar Nerve. *E.Pl.N.* External Plantar Nerve. *I.Pl.A.* Internal Plantar Artery. *E.Pl.A.* External Plantar Artery. *Abd.Hal.* Abductor Hallucis. *F.B.D.* Flexor Brevis Digitorum *Acc.I.* Inner Head of Accessorius. *Abd.M.D.* Abductor Minimi Digiti. *Acc.E.* Outer Head of Accessorius. *P.L.* Peroneus Longus. *P.B.* Peroneus Brevis.

gives off the branch to the first lumbrical muscle. The third and fourth digital nerves may be traced without any special anxiety to the clefts between the 2nd and 3rd

and 3rd and 4th toes. On revicwing this nerve it will be noticed that it supplies three and a half toes, and, if we may regard the one lumbrical as half a muscle, three and a half muscles, namely, the abductor and flexor brevis hallucis, the flexor brevis digitorum, and the innermost lumbrical.

Now follow the *external plantar nerve* [n. plantaris lateralis] which runs obliquely across the sole of the foot towards the base of the fifth metatarsal bone, lying deep to the abductor hallueis and flexor brevis digitorum and superficial to the accessorius and long flexor tendons. Near its beginning look for twigs to the abductor minimi digiti and accessorius, and later on, when the interval between the flexor brevis digitorum and abductor minimi digiti is reached at the level of the base of the fifth metatarsal bone, the nerve will be found to divide into superfieial and deep branches. Only the former can be followed now, sinee the deep braneh dips down among the muscles. Be careful in eleaning this superficial branch, because it often gives off twigs to three muscles whieh are very closely massed together—the flexor brevis minimi digiti, the third plantar, and fourth dorsal interossei. After this the nerve supplies the fourth digital cleft and the outer side of the little toe (see Fig. 179).

The *internal plantar artery* [a. plantaris medialis] begins at the bifureation of the posterior tibial, whieh will be found midway between the internal malleolus and the tuberosity of the ealeaneum. It is a rather small artery which runs along the inner side of the foot, accompanying the internal plantar nerve. As it approaches the big toe it will usually be found communieating with the princeps hallueis branch of the dorsalis pedis, which perforates the first interosseous spaee.

The *external plantar artery* [a. plantaris lateralis] at first lies below the internal on the inner side of the caleaneum. Traee it obliquely across the sole between the first and second layers of plantar muscles accompanying the external plantar nerve nearly to reach the base of the fifth metatarsal

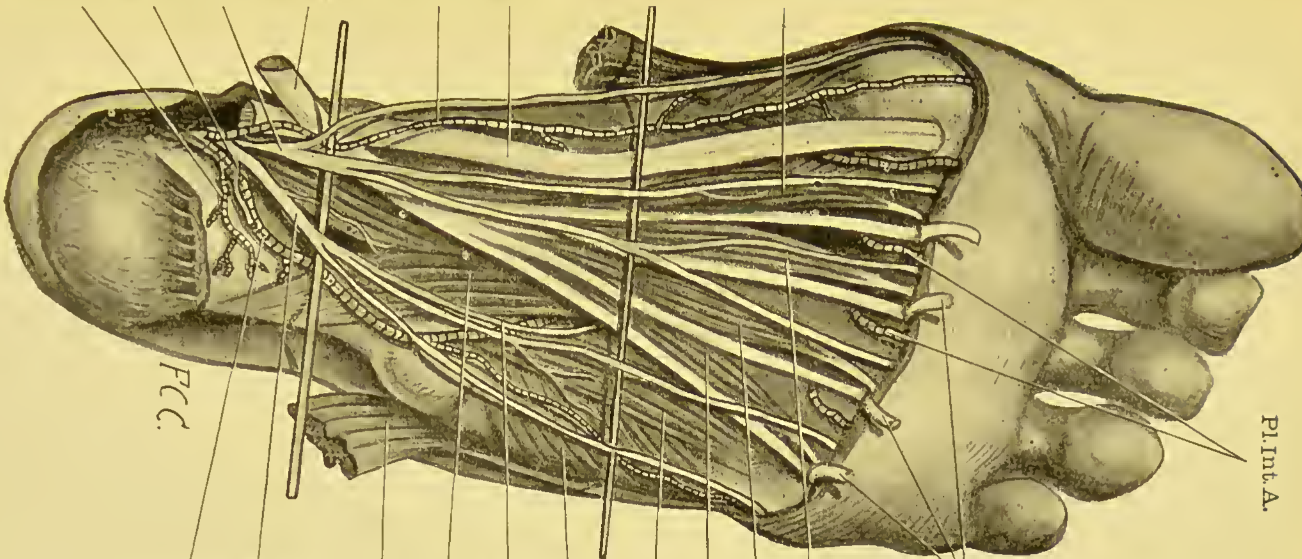


FIG. 179.—DISSECTION OF THE SECOND LAYER OF THE SOLE.

Pl.Int.A. Plantar Interosseous Arteries. *F.B.D.* Flexor Brevis Digitorum Tendons reflected. 1 *L.*, 2 *L.*, 3 *L.*, 4 *L.* The four Lumbricales (notice the Nerve to the First). 3 *Pl.I.* Third Plantar Interosseus Muscle. *F.B.M.D.* Flexor Brevis Minimi Digiti. *E.P.N.D.B.* Deep Branch of External Plantar Nerve. *Acc.* Accessorius. *Abd.M.D.* Abductor Minimi Digiti. *E.Pl.N.* External Plantar Nerve. *E.Pl.A.* External Plantar Artery. *I.Cal.A.* Internal Calcaneal Artery. *N.Ab.M.D.* Nerve to Abductor Minimi Digiti. *I.Pl.N.* Internal Plantar Nerve. *I.Pl.A.* Internal Plantar Artery. *F.L.Dig.* Flexor Longus Digitorum. *F.L.H.* Flexor Longus Hallucis.

bone; here it dips deeply with the deep division of the nerve, and is lost to sight for the present.

Now study the *second layer of the sole muscles.* These are the two long tendons of the flexor longus digitorum and flexor longus hallueis with the museles attaehed to them, namely, the aeeessorius and the four lumbriealcs (Fig. 179).

Piek up the *flexor longus digitorum* tendon where it was last seen behind the internal malleolus. From this point it runs downwards and forwards to the inner side of the sustentaeulum tali. Very soon after this it will be seen erossing superfieial to (below) the flexor longus hallueis, to whieh it sometimes gives or from whieh it sometimes reeeives reinforeing fibres. Direetly after this the tendon divides into four slips for the four outer toes, the outermost of whieh reeeives the insertion of the accessorius, usually on its deep surfaee.

Eaeh tendon runs forwards into the theea of its own toe, one of whieh has already been slit up so that the tendon may be seen piereing that of the flexor brevis digitorum in the manner already deseribed. The insertion will be traeed to the plantar surface of the base of the terminal phalanx of the toe.

The *flexor longus hallucis* was last seen behind the lower end of the tibia just external to the posterior tibial vessels and nerves. It hardly grooves the tibia at all, but on traeing it down behind the ankle-joint it will be seen to groove the baek of the astragalus very deeply and to enter a very definite tunnel of fibrous tissue, whieh should be slit up. This leads it to tho groove below the sustentaeulum tali, after whieh the tendon runs forward, along the inner side of the foot, deep to the flexor longus digitorum to be inserted into the plantar surfaee of the base of the terminal phalanx of the big toe.

The *accessorius* [m. quadratus plantæ] has two heads of origin—an inner, fleshy, from the inncr coneave surface of the caleancum, and an outer, smaller and tcndinous, from just

in front of the external posterior tubercle. As these two heads are traced forward they will be found to unite and become inserted into the deep surface of the flexor longus digitorum tendon. Review once more the nerve supply from the external plantar; there is often a separate branch for each head (Fig. 179).

The *four lumbricales* will be found rising from the tendons of the flexor longus digitorum after it has divided for the toes. Notice that the innermost lumbrical only rises from the inner side of one tendon, while the other three rise from neighbouring sides of two. Each muscle soon narrows into a delicate tendon, and runs forward round the tibial side of its own toe to reach the dorsal expansion of the extensor tendon, where it is inserted. The nerves to these little muscles need a good deal of care to see properly. The nerve to the first or innermost lumbrical has been found already coming from the internal plantar and entering the muscle on its superficial aspect. The nerves to the second and third enter the muscles on their deep surfaces near their tendons. The muscles must be very gently turned aside, when the delicate nerves will be found curving round the distal border of the subjacent adductor transversus hallucis muscle. The nerve to the fourth lumbrical does not enter it so far forward as the other two, because there is here no adductor transversus muscle for it to wind round.

Clear away these muscles of the second layer by cutting the two long flexors where they cross one another, and also the two heads of origin of the accessorius; the whole layer may then be turned forward and the muscles of the third layer displayed.

This *third layer of the sole* consists of four muscles—the flexor brevis hallucis, the adductor obliquus hallucis, the adductor transversus hallucis, and the flexor brevis minimi digiti.

The *flexor brevis hallucis* lies deep to the tendon of the flexor longus, and will be seen to rise from the ligaments on

the inner side of the sole, as well as from a well-marked expansion of the tibialis posticus tendon near its insertion into the tubercle of the navicular bone.

As the muscle runs forward it divides into two fleshy bellies, each of which, as it nears the head of the first metatarsal bone, becomes tendinous, and has a sesamoid bone formed in it before it is inserted into its own side of the plantar surface of the base of the proximal phalanx of the great toe. These sesamoid bones should be carefully studied by freeing the flexor brevis from its origin and turning it forward, but before this is done it will be well to notice once more the nerve supply from the internal plantar entering the muscle on its superficial or plantar surface. Before the sesamoid bones can be turned forward the plantar ligament of the metatarso-phalangeal joint must be divided, as they are embedded in it. It is a very dense ligament, and will be noticed more carefully when the joints are studied. Each sesamoid bone will be found to fit into an antero-posterior groove below the head of the metatarsal bone. Their articular surfaces are therefore convex from side to side, and in this way they may be distinguished when removed from the pisiform bone, for which they are easily mistaken, but this bone always has a flat articular surface.

The *adductor obliquus hallucis* lies on the outer side of the flexor brevis, and rises from the sheath of the peroneus longus tendon, and from the bases of the third and fourth metatarsal bones. It is inserted into the outer side of the plantar surface of the base of the proximal phalanx of the big toe, blending with the outer head of the flexor brevis hallucis.

Its nerve, from the deep division of the external plantar, enters its deep surface, and is best displayed by dividing the muscle near its insertion and turning it backwards and inwards.

The *adductor transversus hallucis* rises from the plantar ligaments of the metatarso-phalangeal joints of the third and

fourth toes, though occasionally it may reach the fifth; it runs transversely across the sole to the outer side of the base of the proximal phalanx of the big toe, where it blends with the adductor obliquus and outer head of the flexor brevis hallueis. Its small nerve, from the deep division of the external plantar, should be looked for entering the musele on its deep surfaee elose to the posterior border.

The peeuliar relation of the nerves supplying the second and third lumbrieals to this muscle has already been noticed.

The *flexor brevis minimi digiti* rises from the plantar surface of the base of the fifth metatarsal bone, and from the adjaeent sheath of the peroneus longus tendon. It is inserted into the outer side of the plantar surfaee of the base of the proximal phalanx of the little toe. Its nerve from the external plantar has already been seen.

When the museles forming this third layer of the sole have been examined, they may be cut and their ends reflected, in order that the deep vessels and nerves and the interosseous museles may be studied.

The *deep branch of the external plantar nerve* should be followed from the point at which it was left, close to the base of the fifth metatarsal bone (see p. 420); it now runs forwards and inwards with the artery, breaking up into numerous branehes, whieh supply the plantar and dorsal interosseous museles, with the exeeption very often of the third plantar and fourth dorsal. The nerves to these have already been notieed (see p. 420). In addition to these trace the whole course of the nerves given off to the three outer lumbrieales.

The *deep plantar arch* [arcus plantaris] is the last part of the external plantar artery, and should now be traced across the sole for the second time; it is deep to the adductor obliquus hallueis, and lying on the plantar side of (superfieial to) the bases of the metatarsal bones and origins of the interosseous muscles.

The areh is completed at the base of the first interosseous space by the end of the dorsalis pedis artery, which was

traced to this spot when the dorsum of the foot was dissected. To those who have dissected the upper extremity the likeness of this arrangement to that of the radial and deep palmar arch will be quite clear.

As it runs across the sole a *plantar interosseous branch* [a. digitalis plantaris] to each space should be looked for. These divide, near the heads of the metatarsal bones, for the neighbouring sides of two toes, and just before this division small communications with the corresponding dorsal interosseous arteries may be found if the injection is good. These are the *anterior perforating arteries*.

Posterior perforating arteries should also be sought at the back part of each interosseous space connecting the plantar arch with the dorsal interosseous arteries passing between the two heads of each dorsal interosseous muscle. In the first space, of course, the posterior perforating artery is the dorsalis pedis, here coming through to complete the plantar arch.

Now isolate the three *plantar interosseous muscles* by pushing a blowpipe or rod deep to them. Remember that the scheme of the interossei of the foot is this—the plantar adduct to the mid line of the second toe (index), and, as the big toe has two special adductors of its own, there is no need for a plantar interosseous to draw it towards the second toe. The three muscles, therefore, will be found in the three outer interosseous spaces, each rising from the tibial surface of the shaft of the metatarsal bone bounding the outer side of the space—the first from the third metatarsal, the second from the fourth, and the third from the fifth. Trace their insertions into the inner (tibial) side of the bases of the proximal phalanges corresponding to the metatarsals from which they arise. In order to do this satisfactorily, it will be necessary to divide the *deep transverse metatarsal ligament* [lig. capitulorum], which runs across the foot, joining the plantar ligaments of the metatarso-phalangeal joints to one another (see Fig. 180).

Cut the plantar interossei, reflect them, and separate the

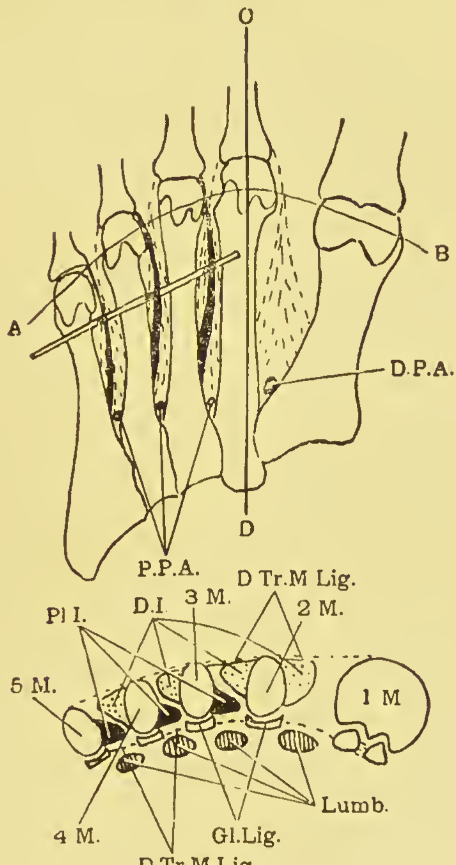


FIG. 180.—PLAN OF THE INTEROSSEOUS MUSCLES OF THE RIGHT FOOT.

A, B. Shows the Plane through which the Section in the lower Diagram has been taken. *C, D.* Line passing through the second Toe to and from which the Interossei act. The Dorsal Interossei are dotted, the Plantar black. *D.P.A.* Dorsalis Pedis Artery. *P.P.A.* Posterior Perforating Arteries. *Pl.I.* Plantar Interossei. *D.I.* Dorsal Interossei. 1, 2, 3, 4, 5 *M.* Heads of corresponding Metatarsal Bones. *D.Tr.M.Lig.* Dorsal Transverse Metatarsal Ligament on the Dorsal Aspect and Deep Transverse Metatarsal Ligament on the Plantar Aspect. *Gl.Lig.* Glenoid Ligaments. *Lumb.* Lumbricales.

toes as widely as possible, a much easier thing to do now that the above-named ligament is divided.

The *dorsal interosseous muscles* are now fully exposed. As there are four of these, there must be one in each interosseus space, but, unlike the plantar muscles, they rise from both the bones which bound the space. Their function is to abduct from the line of the second toe, one being inserted into each side of that toe. The third and fourth must then go to the outer (fibular) side of their own toes, in order to abduct them from the second.

In following out the insertion it will be found that these muscles, like the plantar interossei, are inserted only into the bases of the proximal phalanges, and give no expansion to the extensor tendons, as they do in the hand.

Before leaving these muscles, notice that they are all supplied by the external plantar nerve, and also that the third plantar lies nearer the outer side of the foot than does the fourth dorsal interosseous muscle. There are three small muscles of nearly the same size, and on nearly the same plane, near the outer side of the sole. They are, from without inward: (1) flexor brevis minimi digiti; (2) the third plantar; and (3) the fourth dorsal interosseous muscle (Fig. 179).

Two deep tendons in the sole remain to be noticed—the tibialis posticus and peroneus longus.

Trace the *tibialis posticus* down from behind the internal malleolus, and notice that it passes just above the level of the sustentaculum tali to reach the tubercle of the navicular bone. This is its main insertion, but expansions are given off to all the other bones of the tarsus except the astragalus, and there is usually one very definite expansion from which the flexor brevis hallucis takes origin; it thus serves, when in action, to brace together all the tarsal bones and so maintain the arch of the instep. Where the tendon is close to its insertion, it passes round the inner and lower part of the head of the astragalus and helps to support that bone. Here a sesamoid cartilage or bone is often found in the tendon. It is better to leave the tendon of the peroneus longus until the ligaments of the sole are being dissected.

Before leaving this region notice the great value of the *sustentaculum tali* as a landmark on the inner side of the foot. It cannot easily be felt through the skin, but it will be seen to lie one inch directly below the tip of the internal malleolus. Three tendons pass in close relation to it—the tibialis posticus above, the flexor longus digitorum internal (superficial), and the flexor longus hallucis below (see Fig. 178).

THE JOINTS OF THE LOWER EXTREMITY[1]

The Knee-joint

Recognise carefully all the muscles and tendons in relation with the joint, and work out the movements which each would produce in the joint if pulled.

Review the various *bursæ about the knee*, many of which have been seen already. They are :—

1. The *pre-patellar bursa* (sometimes there are two of these, superficial and deep) (see Fig. 184, p. 435).

2. The *infra-patellar bursa*, which lies behind the ligamentum patellæ. To see it, make a vertical incision through the ligament for its whole length, and turn the edges aside; this will expose a bursal space reaching as high as the upper level of the tibia, which, when explored with a seeker, will be found to be quite separate from the knee-joint (Fig. 184).

3. The *supra-patellar bursa*. This is the upward continuation of the synovial membrane of the knee-joint for about an inch and a half above the top of the patella. It was noticed on a former occasion, when the quadriceps extensor tendon was reflected.

4. The *semi-membranosus bursa*. This was noticed to be common to the semi-membranosus and inner head of the gastrocnemius. Its possible communication with the joint

[1] The dissection of the hip-joint will be found on p. 389.

should be again looked for. Sometimes a separate bursa, deep to the semi-membranosus, is found (see Fig. 181).

5. The *popliteus bursa.* Lift up the cut popliteus muscle and push a seeker deep to it towards the knee-joint. There is very little difficulty in understanding that this bursa is really an expansion of the synovial membrane of the knee along the deep surface of the popliteus.

6. A small bursa where the external lateral ligament splits the insertion of the biceps into the head of the fibula.

7. A bursa between the insertions of the sartorius, semi-tendinosus, and gracilis.

It will be noticed that of these bursæ two always communicate with the joint—the supra-patellar and popliteal—while one may do so, the semimembranosus bursa. The others never do.

Now examine the capsule of the knee all round from the outside. In front is the *ligamentum patellæ,* already noticed, and on either side of it the *lateral patellar ligaments* [retinacula patellæ], which are very ill-defined sheets of fascia continuous with the attachments of the vasti. The outer one [retinaculum laterale] is strengthened by the lower end of the *ilio-tibial band* [tractus ilio-tibialis], which sends its anterior fibres into the outer border of the patella, while the posterior run to the front of the outer tuberosity of the tibia where a tubercle for them is often felt.

Working backward on the outer side the *long external lateral ligament* [lig. collaterale fibulare] is reached; clear it carefully from its surroundings and notice its cord-like structure. Above it will be found attached to the summit of the external tuberosity of the femur, while below it reaches the outer side of the head of the fibula. Notice that when the knee-joint is extended the ligament stretches from above downwards and backwards. Deep to the long external lateral ligament, and on a level with the actual joint, look for the *inferior external articular artery,* and, still deeper, for the tendon of the popliteus where it rises

from the condyle. Behind the long, the *short external lateral ligament* should be made out; below it is attached to the styloid process of the fibula and above to the external

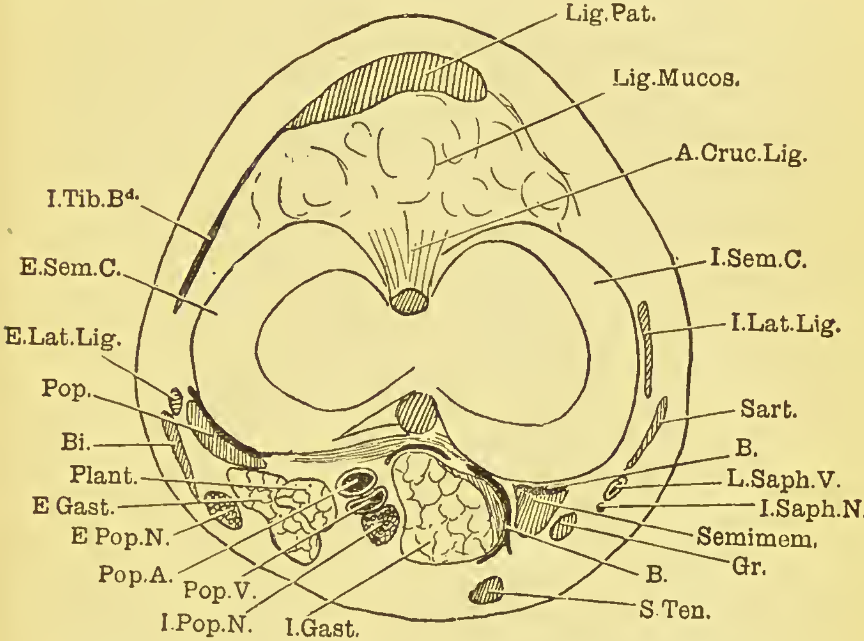


FIG. 181.—TRANSVERSE SECTION OF THE LEFT LEG THROUGH THE KNEE-JOINT. (TRACED WITH A DIAGRAPH.)

Lig.Pat. Ligamentum Patellæ. *Lig.Mucos.* Fat in the Ligamentum Mucosum. *A.Cruc.Lig.* Anterior Crucial Ligament. *I.Sem.C.* Internal Semilunar Cartilage. *E.Sem.C.* External Semilunar Cartilage. *I.Lat.Lig.* Internal Lateral Ligament. *E.Lat.Lig.* Long External Lateral Ligament. *Sart.* Sartorius. *B.* Bursa. *L.Saph.V.* Long Saphenous Vein. *I.Saph.N.* Long Saphenous Nerve. *Semimem.* Semimembranosus. *Gr.* Gracilis. *S.Ten.* Semi-tendinosus. *I.Gast.* Inner Head of Gastrocnemius. *E.Gast.* External Head of Gastrocnemius. *Pop.A.* Popliteal Artery. *Pop.V.* Popliteal Vein. *I.Pop.N.* Internal Popliteal Nerve. *E.Pop.N.* External Popliteal Nerve. *Plant.* Plantaris. *Bi.* Biceps. *Pop.* Popliteus. *I.Tib.B.* Ilio-tibial Band.

condyle a little behind the tuberosity, though it very often attaches itself to the popliteus tendon on the way from the one to the other.

At the back the condyles are covered by a portion of the

capsule from which the heads of the gastrocnemius are rising in part, while in the middle is a strong oblique band reflected, from the insertion of the semi-membranosus on the inner

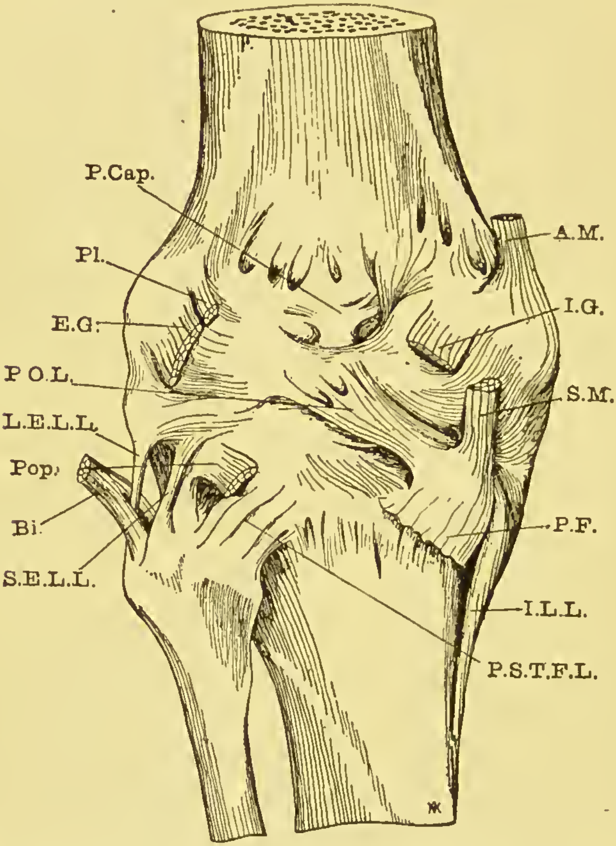


FIG. 182.—THE CAPSULE OF THE LEFT KNEE-JOINT FROM BEHIND.

P.Cap. Posterior True Capsule. *Pl.* Plantaris. *E.G.* Outer Head of Gastrocnemius. *P.O.L.* Posterior Oblique Ligament of Winslow. *L.E.L.L.* Long External Lateral Ligament. *Pop.* Popliteus. *Bi.* Biceps. *S.E.L.L.* Short External Lateral Ligament. *P.S.T.F.L.* Posterior Superior Tibio-fibular Ligament. *I.L.L.* Internal Lateral Ligament. *P.F.* Popliteal Fascia. *S.M.* Semi-membranosus Insertion. *I.G.* Inner Head of Gastrocnemius. *A.M.* Adductor Magnus Tendon.

side, upwards and outwards, to just above the external condyle. This is the *oblique posterior ligament of Winslow* [lig. popliteum obliquum].

On the inner side of the joint is the *long internal lateral ligament* [lig. collaterale tibiale], the upper attachment of which is, like that of the long external ligament, to the summit of the tuberosity. Unlike the external, however, it runs downwards and forwards, and usually attaches itself rather closely to the internal semilunar cartilage. After this it becomes attached to the internal margin of the tuberosity, and is then continued downwards and forwards for another two inches along the shaft of the tibia. Notice that the *inferior internal articular* artery passes deep to this continuation of the ligament, and is therefore on a much lower level than is the inferior external articular.

Now turn down the patella and look carefully into the joint. If the *ligamentum mucosum* [plica synovialis patellaris] has not been torn, it will catch the eye at once as a delicate fold attached to the place where the trochlear surface of the femur ends and the intercondylar notch begins; as it approaches the patella it enlarges and swells into a cushion of fat encased in synovial membrane, while a wing-like expansion projects from the cushion on either side of the stalk-like part. These are the *ligamenta alaria* [plicæ alares], and are very useful in filling inequalities during the changing shape of the moving knee. While the joint is still undisturbed, bend it to varying degrees, and notice how during flexion the patella gradually slides off the trochlear surface and rests against the lower surfaces of the condyles, though much more against the outer than the inner.

The accompanying section (Fig. 183) shows how useful the ligamentum mucosum is in filling the gap between the patella and femur when the lower parts of the articular surfaces are not in contact. It also shows the synovial fringes which sometimes enlarge and cause trouble.

Divide the attachment of the ligamentum mucosum to the femur and turn it forward with the patella; this will allow the anterior parts of the semilunar cartilages and of the

anterior crucial ligament to be seen, but, in order to understand these structures properly, the femur should be sawn

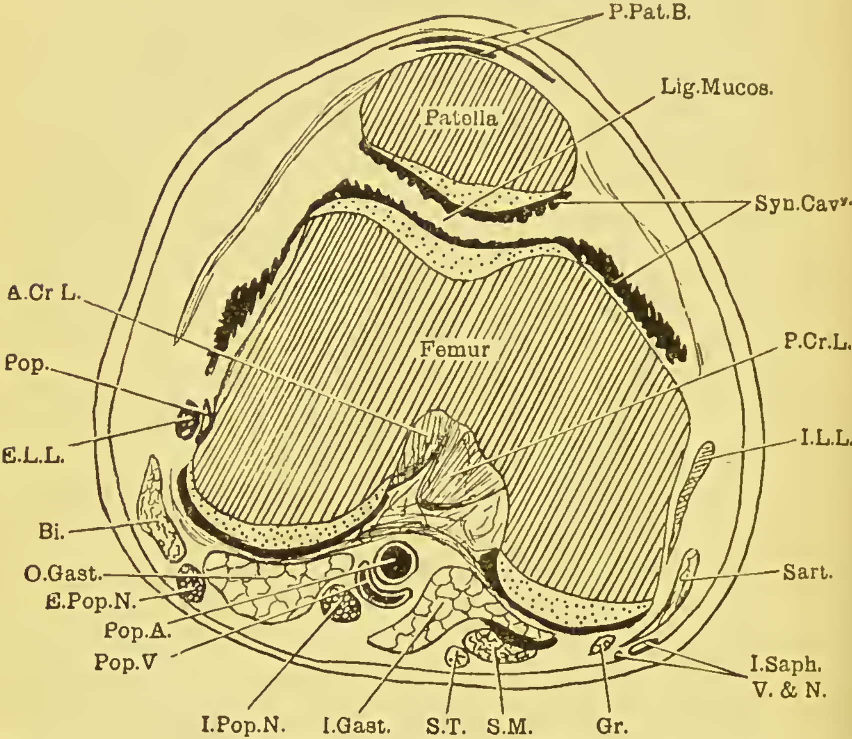


FIG. 183.—HORIZONTAL SECTION THROUGH THE LEFT THIGH AT THE LEVEL OF THE CONDYLES OF THE FEMUR. (TRACED WITH THE DIOPTOGRAPH.)

P.Pat.B. Prepatellar Bursæ. *Lig.Mucos.* Ligamentum Mucosum rising up between those parts of the Articular Surfaces which are not, at the time, in contact. *Syn.Cav.* Synovial Cavity, showing the fringing of the Synovial Membrane. *A.Cr.L.* Anterior Crucial Ligament. *P.Cr.L.* Posterior Crucial Ligament. *I.L.L.* Internal Lateral Ligament. *E.L.L.* Long External Lateral Ligament. *Sart.* Sartorius. *I.Saph.V. & N.* Internal Saphenous Vein and Nerve. *Gr.* Gracilis. *S.M.* Semi-membranosus. *S.T.* Semi-tendinosus. *I.Gast.* Inner Head of Gastrocnemius. *O.Gast.* Outer Head of Gastrocnemius. *Pop.A.* Popliteal Artery. *Pop.V.* Popliteal Vein. *I.Pop.N.* Internal Popliteal Nerve. *E.Pop.N.* External Popliteal Nerve. *Bi.* Biceps. *Pop.* Popliteus.

across about four inches above its lower end and then a sagittal section made of the lower part, trying to keep the

saw as much as possible in the middle line of the bone, so that it may divide the trochlea surface evenly, and open the middle of the anterior part of the intercondylar notch.

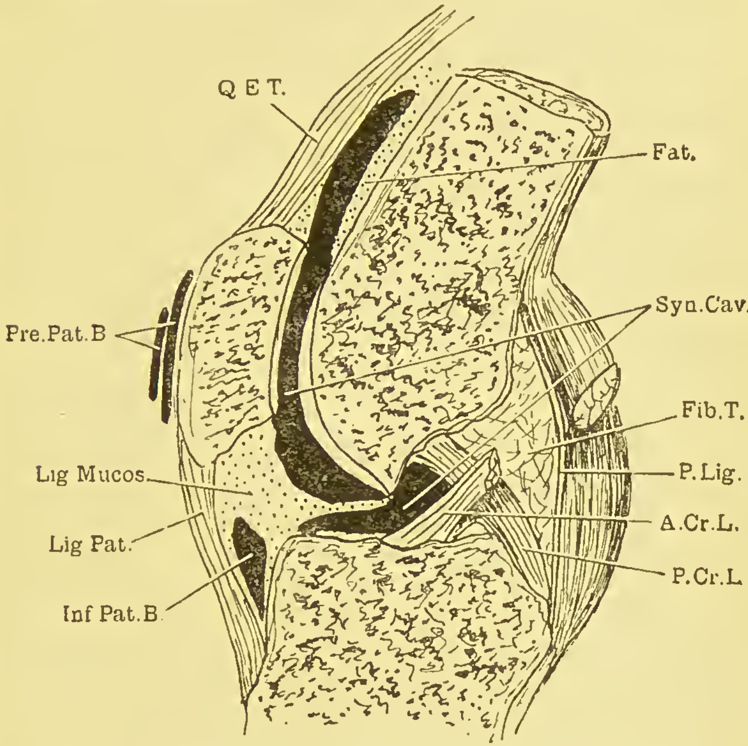


FIG. 184.—SAGITTAL SECTION THROUGH THE KNEE-JOINT.

Q.E.T. Quadriceps Extensor Tendon. *Syn.Cav.* Synovial Cavity. *Pre.Pat.B.* Prepatellar Bursæ. *Lig.Mucos.* Ligamentum Mucosum. *Lig.Pat.* Ligamentum Patellæ. *Inf.Pat.B.* Infra-patellar Bursa. *Fib.T.* Fibrous Tissue between the Posterior Crucial and Posterior Ligaments. *P.Lig.* Posterior Ligament. *A.Cr.L.* Anterior Crucial Ligament. *P.Cr.L.* Posterior Crucial Ligament.

When this has been done the two condyles may be turned aside from one another and the crucial ligaments studied.

The *anterior crucial ligament* [lig. cruciatum anterius] is attached in front of the spine and runs upwards, backwards, and outwards to the external condyle at the outer and back part of the intercondylar notch.

The *posterior crucial ligament* [lig. cruciatum posterius] has its lower attachment to the posterior margin of the head of the tibia, from which it runs very much forwards and also upwards and inwards to the outer surface of the internal condyle at the front of the inner side of the intercondylar notch.

It will thus be seen that, whether these crucial ligaments are looked at from the front or side, they form an X, and the spine of the tibia fits into the lower ∧ of the X.

Dissect away the posterior ligament of the knee-joint from the posterior crucial ligament, and notice that there is no synovial membrane between them, but that an oblique band from the back part of the external semilunar cartilage runs up behind the posterior crucial ligament to the internal condyle. This is known as the *ligament of Wrisberg*, and must not be confused with another oblique band which sometimes passes from the same semilunar cartilage to the internal condyle in front of the posterior crucial ligament—the *ligament of Humphry*.

Now remove the external condyle altogether by cutting through the outer part of the capsule, the tendon of the popliteus, and the anterior crucial ligament close to the femur.

The whole of the *external semilunar cartilage* [meniscus lateralis] will now be seen from above as a horse-shoe-shaped pad of fibro-cartilage with three surfaces. The upper surface is concave to adapt it to the convex condyle, for which it forms a socket, while the lower surface is flat to glide on the cartilage-covered head of the tibia. The peripheral or marginal surface is narrow, and rests against the tendon of the popliteus and the inferior external articular artery.

The two horns or cornua of the crescent attach the cartilage to the tibia just in front and behind the spine. Cut the cartilage right across just in front of the place where the popliteus crosses it; this will show its triangular section, and also that it is bound to the margin of the head of the tibia by a

fibrous membrane—the *coronary ligament*—which is attached to its lower and outer border all the way round except where the popliteus tendon passes it; here the coronary ligament fails, and the synovial membrane of the knee is prolonged down the deep surface of the tendon as has already been noticed.

Clear away the internal condyle in the same way as the external, and contrast the *internal semilunar cartilage*

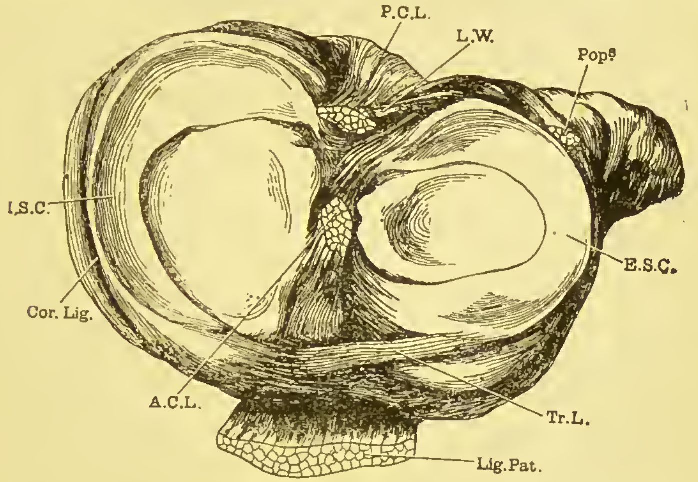


FIG. 185.—INTRA-ARTICULAR STRUCTURES OF LEFT KNEE-JOINT.

P.C.L. Posterior Crucial Ligament. *L.W.* Ligament of Wrisberg. *Pop^s.* Popliteus. *E.S.C.* External Semilunar Cartilage. *Tr.L.* Transverse Ligament. *Lig.Pat.* Ligamentum Patellæ. *A.C.L.* Anterior Crucial Ligament. *Cor.Lig.* Coronary Ligament. *I.S.C.* Internal Semilunar Cartilage.

[meniscus medialis] with the external one. Notice that it is a much more open crescent, its anterior cornu being attached in front of the anterior crucial ligament, while behind its posterior cornu fixes it to the tibia behind the posterior attachment of the external semilunar cartilage, but in front of the posterior crucial ligament.

The internal semilunar cartilage is narrower than the external except in its posterior third, where it usually broadens out. There are two other points of difference of

considerable clinical importance; one is that the internal lateral ligament is attached to the marginal surface, and the other that the coronary ligament is not so lax as that on the outer side, and so is more likely to be torn in a sudden wrench of the knee, while the attached internal lateral ligament tends to drag the cartilage out of its place. For these reasons, although it is normally the less movable of the two, displacement of the internal semilunar cartilage is a fairly common accident, especially among football players.

The two semilunar cartilages will be seen to be connected anteriorly by a narrow transverse band sunk in the substance of the ligamentum mucosum, and known as the *transverse ligament.*

A last glance at the two semilunar cartilages or menisci will satisfy the dissector as to their value: (1) for deadening shocks; (2) for adapting their shape to the changing curvature of the condyles during flexion and extension; and (3) for allowing the hinge movement of the knee to take place between them and the condyles, while the rotatory movement occurs between their flat lower surfaces and the head of the tibia.

Finally revise and carefully note the various structures lying along the middle of the head of the tibia from behind forward. Most posteriorly of all is the posterior ligament, then the posterior crucial ligament, then the internal semilunar cartilage, and in front of that the two cornua of the external cartilage embracing the spine; more anteriorly is the anterior crucial ligament, then the internal semilunar cartilage, and, lastly, the transverse ligament and ligamentum mucosum.

The Tibio-fibular Joints

Clean all the loose tendons away from the leg, and, if it is very dry, soak it in water for twenty-four hours.

Notice that the fibula is bound to the tibia by the superior, middle, and inferior tibio-fibular articulations.

In the *superior tibio-fibular joint* the head of the fibula is bound to the external tuberosity of the tibia by strong anterior and posterior ligaments which allow only slight gliding between the two cartilage-covered surfaces; this, therefore, is a good example of the arthrodial or gliding joint. Notice that the tendon of the popliteus passes close behind this articulation, so that the bursa accompanying the tendon and derived from the knee-joint sometimes opens into the tibio-fibular joint. When this is the case the superior tibio-fibular joint, of course, communicates indirectly with the knee.

The *middle tibio-fibular joint* is simply the interosseous membrane which runs downwards and outwards from the tibia to the fibula. It is wanting for a short distance above and below where the anterior tibial and anterior peroneal arteries pass through.

The *inferior tibio-fibular joint* is what is known as a *syndesmosis*, that is, the opposed bony surfaces are bound together in almost their whole extent by fibrous tissue, and are not covered by a layer of articular cartilage as they would be in a symphysis.

There is also a strong anterior and posterior *inferior tibio-fibular ligament* [lig. malleoli lateralis] joining the bones, so that they are hardly ever torn away from one another during life. If the posterior inferior tibio-fibular ligament is carefully cut through, another ligament—the *inferior transverse*—is seen joining the two bones deep to it; this completes the socket for the astragalus, and the bevelled postero-external border of that bone plays against it.

The Ankle-joint

The capsule of this joint is divided into anterior and posterior and external and internal lateral ligaments.

The *anterior ligament* is liable to be eleaned away unless great eare is taken, beeause it is very thin, and is separated from the synovial membrane of the joint by a pad of fat. The disseetor sees the fat through the ligament, elears it

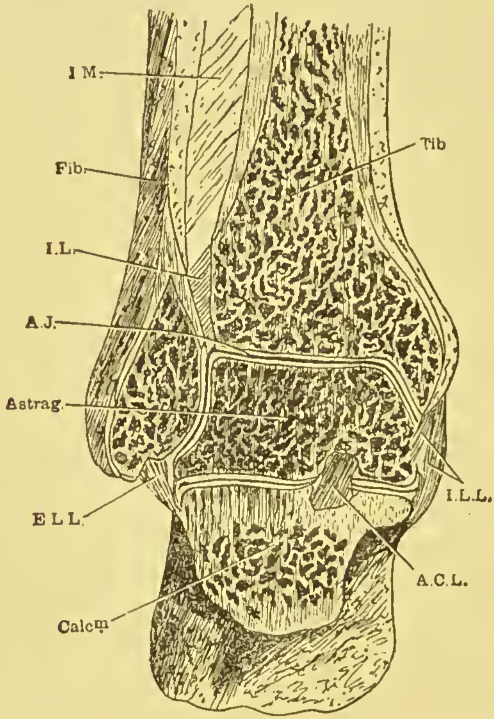


Fig. 186.—Coronal Section through the Ankle and Astragalo-calcaneal Joints of the Right Foot.

I.M. Interosseous Membrane. *I.L.* Inferior Interosseous Ligament. *A.J.* Ankle-joint. *A.C.L.* Interosseous Astragalo-calcaneal Ligament. On the Tibial side of this is the Anterior Astragalo-calcaneal Joint, while the Posterior Astragalo-calcaneal Joint lies on the Fibular side. *E.L.L.* External Lateral Ligament. *I.L.L.* Internal Lateral Ligament.

away, and then finds himself in the joint eavity. It is advisable, before disseeting this ligament, to plantar flex the ankle as mueh as possible.

In disseeting the *posterior ligament* dorsiflex the ankle as far as possible, and begin the disseetion in the upper part

of the digital fossa behind the external malleolus; the ligament is attached rather strongly here, and its fibres radiate inwards, some running up to the lower border of the tibia, others downwards to the posterior border of the astragalus.

The *external lateral ligament* consists of three strong, quite separate fasciculi, radiating from the external malleolus. The anterior fasciculus [lig. talo-fibulare anterius] runs nearly horizontally inwards to the neck of the astragalus. The middle fasciculus [lig. calcaneo-fibulare] runs downwards and a little backwards from just in front of the tip of the malleolus to the outer side of the calcaneum, while the posterior fasciculus [lig. talo-fibulare posterius] runs from the digital fossa, again almost horizontally, to the outer lip of the groove for the flexor longus hallucis tendon behind the astragalus (see Fig. 187).

The *internal lateral ligament* [lig. deltoideum] is a broad, fan-shaped sheet, the apex of which is attached to the internal malleolus, while its base is attached, from before backwards, to the tubercle of the navicular, the calcaneo-navicular ligament, the sustentaculum tali. and the inner side of the astragalus.

Now cut through the capsule and turn the astragalus out of the bony arch which the tibia and fibula make for it. Notice particularly that its upper articular surface is broader in front than behind. If it were not for this a backward dislocation of the ankle would be of constant occurrence. There is little need to impress on any one who has dissected the joint that the lateral ligaments are of infinitely greater importance than the anterior and posterior.

Tarsal Joints

First examine the *transverse tarsal joint* from the dorsum of the foot. This is the articulation which runs across the foot, having the head of the astragalus and the anterior surface of the calcaneum behind, and the navicular and cuboid

in front. It is a great advantage in studying these joints to have the bones of an articulated foot for comparison.

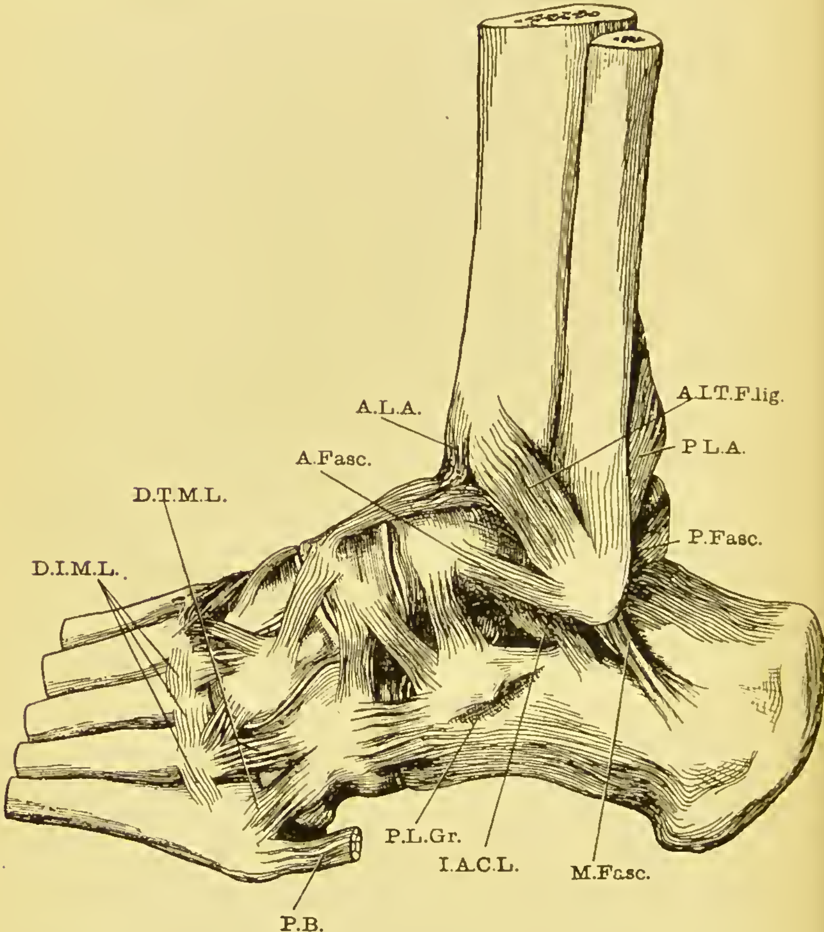


FIG. 187.—LIGAMENTS OF THE ANKLE AND OF THE DORSUM OF THE FOOT.

A.L.A. Anterior Ligament of Ankle. *A.Fasc.* Anterior Fasciculus of External Lateral Ligament of Ankle. *M.Fasc.* Middle Fasciculus of External Lateral Ligament of Ankle. *P.Fasc.* Posterior Fasciculus of External Lateral Ligament of Ankle. *D.T.M.L.* Dorsal Tarso-metatarsal Ligaments. *D.I.M.L.* Dorsal Intermetatarsal Ligaments. *P.B.* Peroneus Brevis Tendon. *P.L.Gr.* Groove for Peroneus Longus. *I.A.C.L.* The Anterior End of the Interosseous Astragalo-calcaneal Ligament.

Cut through the dorsal astragalo-navicular and dorsal calcaneo-cuboid ligaments, and separate the bones from

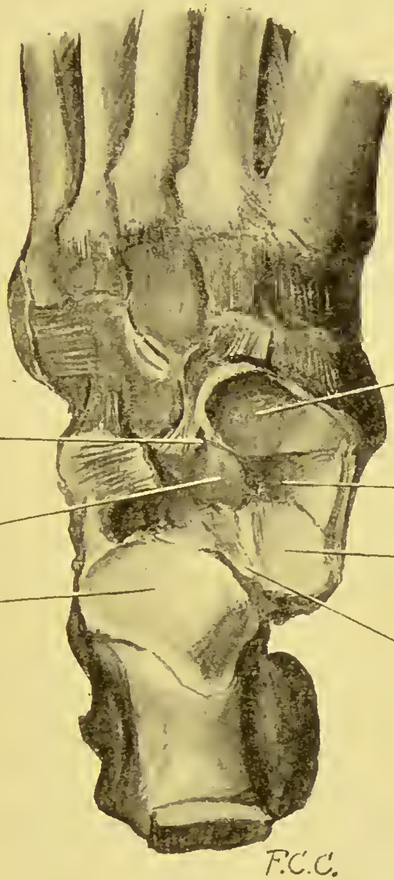


FIG. 188.—RIGHT FOOT FROM WHICH THE ASTRAGALUS HAS BEEN REMOVED IN ORDER TO SHOW ITS BED.

Nav.F. Posterior Concave Facet on the Navicular Bone. *Spr.Lig.* Inferior Calcaneo-navicular or Spring Ligament. *Sus.Tali.* Sustentaculum Tali Facet. *Ast.Calc.Lig.* Interosseus Astragalo-calcaneal Ligament which has been divided. *P.A.Calc.F.* Posterior Astragalo-calcaneal Facet. *A.Calc.F.* Anterior Facet on Calcaneum. *E.Cal.Nav.Lig.* External Calcaneo-navicular Ligament.

above, when it will usually be seen that the calcaneo-cuboid part of the articulation is quite distinct from the astragalo-

navicular, a fairly strong ligament—the *external calcaneo-navicular*—intervening.

Now excise the astragalus from its bed by cutting the *interosseous astragalo calcaneal ligament* [lig. talo-calcaneum mediale], a rather difficult proceeding, since it lies in a bony tunnel formed by opposing grooves in the two bones. When this is divided, very little more cutting will be necessary in order to free the astragalus. Lift it out, and notice that it occupies two articular cavities, a larger antero-internal and a smaller postero-external. The larger cavity is formed by the concave posterior surface of the navicular bone in front, by the sustentaculum tali of the calcaneum behind and below, and by the *inferior calcaneo-navicular* or *spring ligament of the foot* [lig. calcaneo-naviculare plantare] connecting these two, and forming the support for a large area of the head of the astragalus.

Externally the socket is completed by the *external calcaneo-navicular ligament,* as well as in most cases by a facet on the antero-internal part of the upper surface of the calcaneum. Behind the articular cavity is bounded by the already cut interosseous astragalo-calcaneal ligament.

This cavity is of great importance in the mechanism of the foot, and, it will be seen, forms part of two joints which are usually considered separately in systematic text-books. The anterior part, between the navicular and head of the astragalus, is the inner part of the TRANSVERSE TARSAL JOINT and is often regarded as a ball and socket rather than a mere gliding joint, while the posterior part is the *anterior astragalo-calcaneal articulation* (see Fig. 188).

The position of the tibialis posticus tendon, just below the spring ligament, is of great importance in helping that structure to support the pressure of the head of the astragalus.

The *posterior astragalo-calcaneal joint* lies behind the interosseous calcaneo-astragalar ligament, which, of course, forms the anterior part of its capsule; elsewhere its capsule

is slight. Notice how convex the articular surface is on the calcaneum, and how much forward it looks as well as upward.

If another foot, on which the joints have not yet been dissected, is referred to, it will be noticed that the transverse tarsal joint allows a certain amount of hinge movement or dorsal and plantar flexion, thus carrying on the movement of the ankle; there is present, however, in addition, a rotatory movement of the front part of the foot round an antero-posterior or longitudinal axis passing between the cuboid and navicular bones. This, of course, results in eversion or inversion of the sole, and a good deal of help is given to this movement at the calcaneo-astragalar joints.

The other tarsal joints should be examined from the dorsal aspect and their positions determined by the division of the dorsal ligaments binding them together. After division of the dorsal ligaments it will not be found possible to separate the distal row of bones, *i.e.* the three cuneiforms and cuboid, very far, because they are firmly bound together by strong interosseous ligaments at the non-articular parts of their opposed surfaces.

It is on these ligaments that the transverse arch of the foot largely depends for keeping its shape under pressure.

It will be convenient, while working on the dorsum, to open up and examine the TARSO-METATARSAL joints, the dorsal ligaments of which consist of longitudinal and oblique bands.

In the case of the big toe the joint is quite distinct, and has a complete capsule of its own, but in the others one joint cavity is shared between two metatarsal bones; thus there is one for the second and third and another for the fourth and fifth. The dissector is advised to examine very carefully whether these cavities communicate with the larger synovial joint between the anterior tarsal bones. In the writers' experience they do not, or, when they do, it is only on the inner side of the second metatarsal bone between the inner and middle cuneiform bones. This, however, is not the arrangement which is usually depicted in standard text-books.

The most important point is to notice the way in which the base of the seeond metatarsal is let in between the inner and outer euneiform bones.

INTER-METATARSAL JOINT CAVITIES extend a little way between the bases of the four outer metatarsal bones and are eontinuous with the tarso-metatarsal eavities. They are provided with dorsal, plantar, and interosseous ligaments [ligg. basium].

THE METATARSO-PHALANGEAL JOINTS

First lay open this joint in the great toe from the dorsum, remembering its great elinieal importanee in gouty people; notice how feeble the dorsal part of the eapsule is, though the lateral and plantar parts are thiek and strong. Two sesamoid bones have already been seen embedded in the plantar ligament, their eartilage-covered faees playing against the grooves on the plantar surfaee of the head of the metatarsal bone. Notiee that the concave artieular surface on the base of the proximal phalanx of this toe is obliquely plaeed, so that the toe is direeted outwards towards the others, giving the foot a somewhat pointed end. This arrangement is found in races whieh have never worn boots, so that "anatomical boots" with straight inner sides have nothing really to justify them in anatomy.

The other metatarso-phalangeal joints differ from that of the great toe in their small size and lateral eompression of the artieular surfaees on the heads of the metatarsal bones. There are no sesamoid bones in the plantar or *glenoid ligaments*, whieh are very dense, exeept near their metatarsal attachment. These ligaments are joined together by the *deep transverse metatarsal ligament* (see p. 426). As these joints allow abduction and adduetion as well as flexion and extension, they are ealled eondyloid joints or eondylarthroses.

The INTER-PHALANGEAL ARTICULATIONS allow only flexion

and extension, and are therefore ginglymus or hinge joints. If one is laid open from the dorsum it will be seen that the capsule closely resembles that of the metatarso-phalangeal joints, the dorsal ligament being very weak indeed, while the plantar and lateral are strong.

The Ligaments of the Sole

Three ligaments are of great importance in the sole; they are the inferior calcaneo-navicular and the long and short calcaneo-cuboid.

The *inferior calcaneo-navicular ligament* has been seen from above and should now be studied from below, the tibialis posticus tendon being drawn aside or removed. From this point of view it consists of fibrous bundles running forwards and inwards from the sustentaculum tali to the under surface of the navicular, instead of being smooth and cartilaginous in texture as it is above. Its large amount of elastic fibres give it the alternative name of the spring ligament (Fig. 189).

The *long calcaneo-cuboid* or *long plantar ligament* [lig. plantare longum] stretches from the under surface of the calcaneum, between the posterior and anterior tubercles, to the ridge on the cuboid which forms the posterior lip of the groove for the peroneus longus tendon. From this attachment it is prolonged forward to the bases of the second, third, fourth, and sometimes the fifth metatarsal bones, in this way forming a sheath for the *peroneus longus*. Slit open this sheath, and notice that where the peroneus longus is turning round the outer edge of the foot a sesamoid cartilage is developed in it. Very rarely this may be ossified. Notice that the tendon does not occupy the outer part of the groove in the cuboid except in extreme dorsiflexion and eversion of the foot.

Follow the tendon to its insertion into the base of the first metatarsal bone and the neighbouring part of the internal cuneiform.

The *short calcaneo-cuboid* or *short plantar ligament* [lig. plantare breve] may be seen a good deal of before the long is divided, but when that is done the whole of it comes

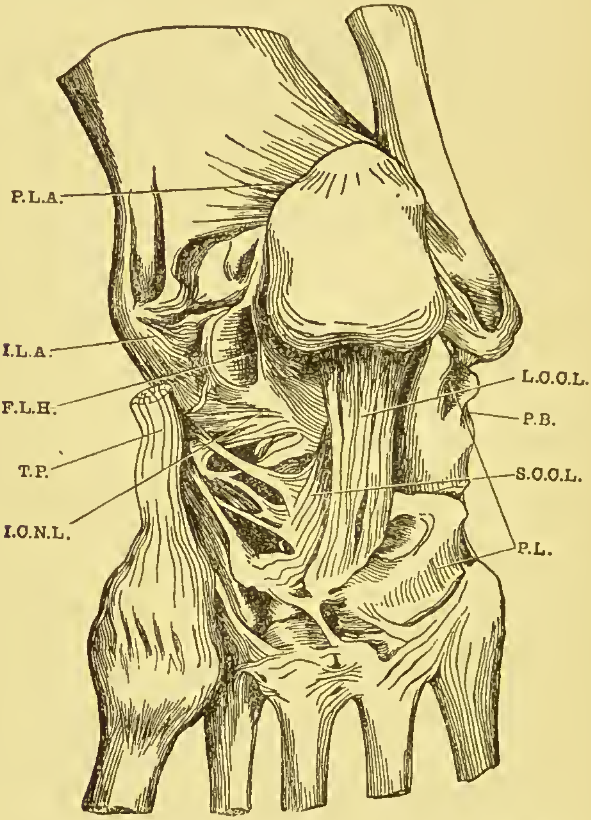


FIG. 189.—LIGAMENTS OF THE SOLE OF THE FOOT.

P.L.A. Posterior Ligament of Ankle. *I.L.A.* Internal Lateral Ligament of Ankle. *F.L.H.* Groove for Flexor Longus Hallucis. *T.P.* Tibialis Posticus. *I.C.N.L.* Inferior Calcaneo-navicular Ligament. *P.L.* Grooves for Peroneus Longus. *P.B.* Groove for Peroneus Brevis. *L.C.C.L.* Long Calcaneo-cuboid Ligament. *S.C.C.L.* Short Calcaneo-cuboid Ligament.

into view; its fibres run obliquely forwards and inwards from the anterior tubercle of the calcaneum to the plantar surface of the cuboid behind the ridge just mentioned.

THE PLANTAR ARCHES.—In reviewing the mechanism of

the foot it will be seen that the weight is transmitted to the astragalus, which is supported on a tripod. The posterior limb is the calcaneum, the antero-internal limb the heads of the three inner metatarsals, the antero-external limb the two outer metatarsals. Three arches are present in such a tripod, an inner and outer longitudinal and a transverse.

The *inner longitudinal arch* is the most important; in it the calcaneum is the posterior pier, the astragalus the key-stone and the navicular, three cuneiforms and three inner metatarsals the anterior pier. The *inferior calcaneo-navicular* ligament acts as a "tyer" to this arch, joining the two piers just below the keystone and also supporting the keystone. The obliquity of the astragalus transmits the weight of the body to the anterior pier of this arch, and the number of segments in this pier, in addition to the presence of the elastic spring ligament, serve to break the shock of a jump provided the jumper has the sense to alight as much as possible on the ball of the big toe.

The *outer longitudinal arch* is simpler and has the calcaneum for its posterior pier, while the anterior pier is formed by the cuboid and two outer metatarsals. The two long and short plantar ligaments act as "tyers" to this arch. It does not play as important a part as the inner arch, because the toes are turned out.

The *transverse arch* is best seen by making a section through the three cuneiform bones and the cuboid, when it will be noticed that its dorsal convexity is maintained chiefly by the strong interosseous ligaments which bind these bones together. A good deal of the shock of a jump on to the toes is expended in splaying out this arch as far as the ligaments will allow.

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